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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.
ISSUED WEEKLY BY THE AMERICAN MACHINIST PRESS,
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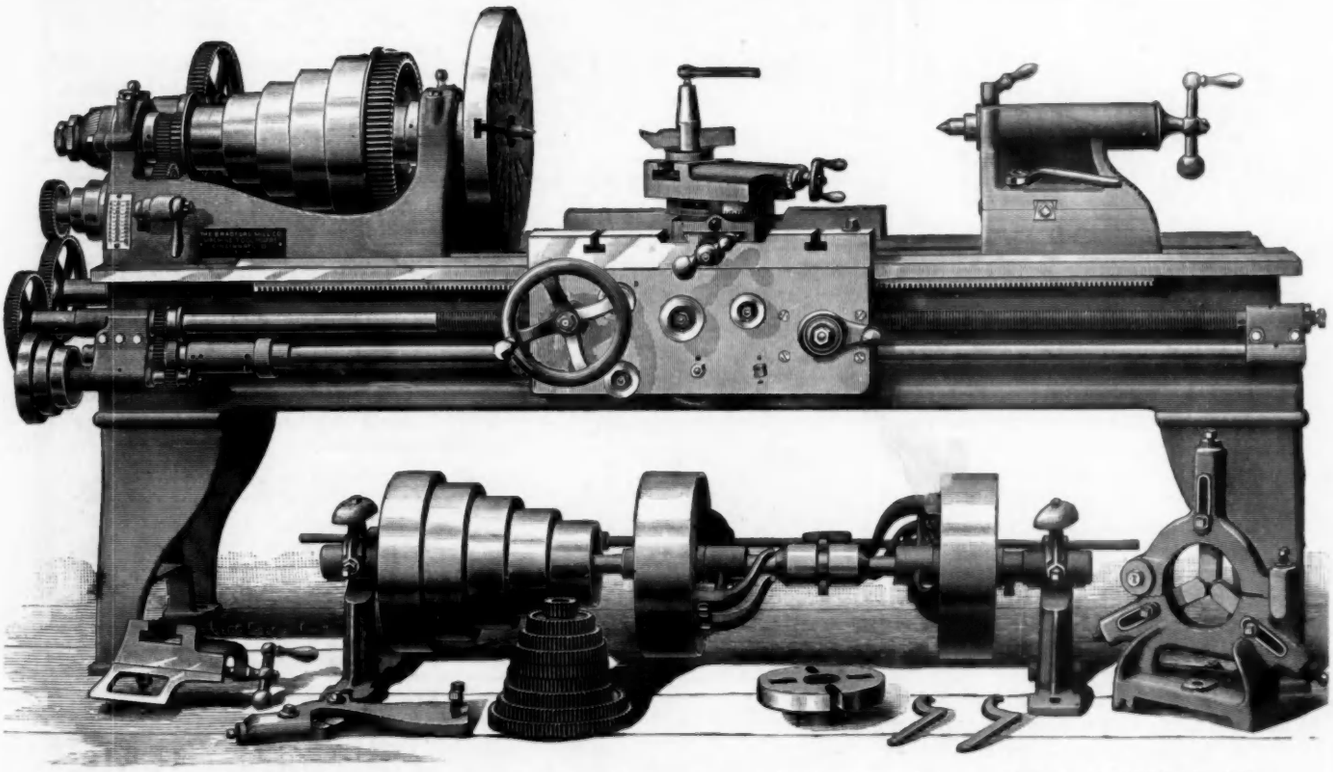

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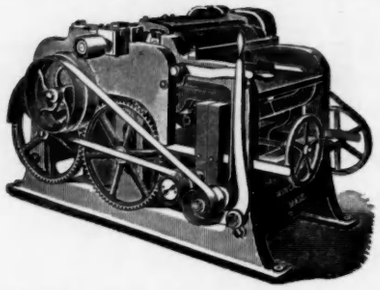

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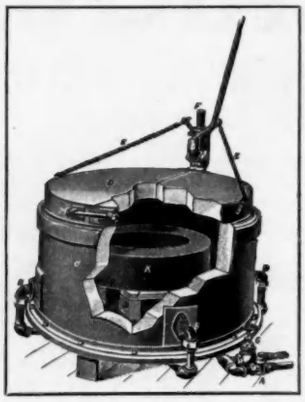

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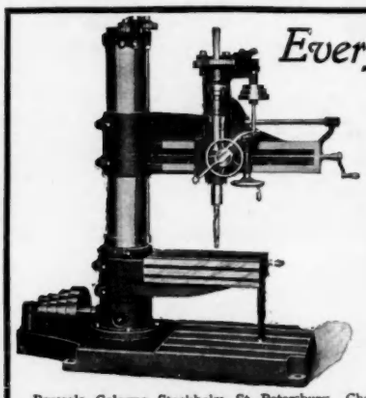

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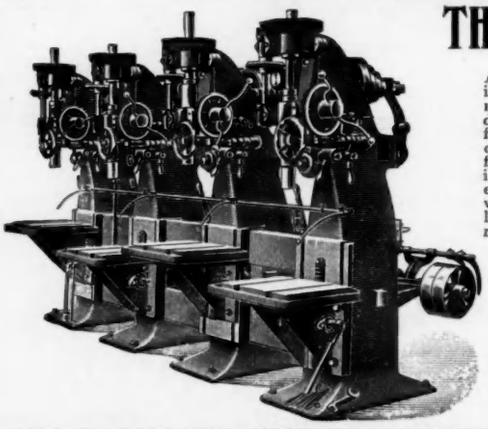

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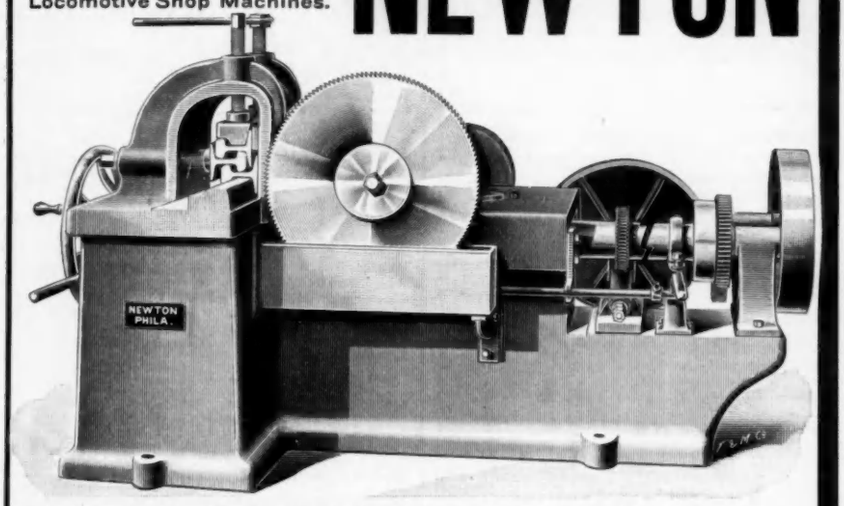

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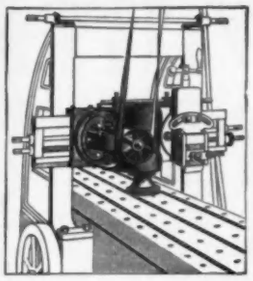

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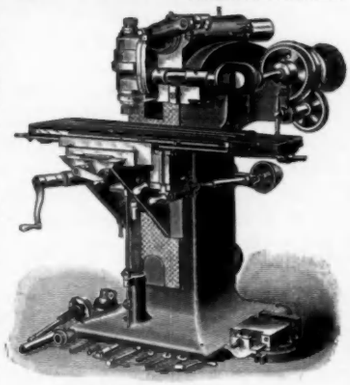

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Some Special Commercial Methods.

It is doubtful if there ever was a time before in this country when tool-building shops were so crowded with orders and so universally unable to fill them promptly as they are now. This condition has, of course, led to some unusual measures being taken to protect various interests, and we know of at least one concern that has adopted a rather novel plan for protecting itself against future advances in cost of material and finished products. This concern manufactures a certain standard machine tool which it puts through the shops in large numbers, and the date of delivery is sometimes fixed at what seems like a rather remote period. As no one can tell what prices will be at that time, orders are accepted at a price to be fixed on the first day of the month of delivery, with the privilege of cancellation by the buyer, if he is at that time dissatisfied. It is true that some buyers might consider this a hardship, in view of the fact that cancellation of an order after waiting perhaps several months would mean a serious additional delay, and would enable the seller to fix prices to suit himself, with little or no regard to competition; but at present the buyer of machine tools can have things his own way to a very small extent at best, and it is extremely doubtful if he fares any better when placing orders at prices based more or less upon the maker's attempts to look into the future and put his present prices high enough to fully protect himself.

Another thing which this concern does is to limit the number of orders accepted from any one dealer to a fair proportion with reference to the wants of others. The object of this being to prevent its sales business being absorbed by one or a few concerns, and thus be placed at their mercy at the end of the present period of activity, when all possible channels for the disposal of machines may be urgently needed.

Some Possibly Deceptive Ecomomies.

It is just possible that some of the people who have become interested in the modern trade combinations popularly known as trusts are deceiving themselves as to the real condition of affairs. We are all more or less familiar with the methods by which it was expected that economies could be introduced, and chief, or, at least prominent, among these was the expectation that the services of a good many expensive men could be dispensed with; especially salesmen, with their liberal salaries and equally liberal expense accounts.

We could name the managers of at least one combination who show in their statement, reviewing the year's work, a saving of a good many thousands of dollars by this means, but the statement omits to inform the stockholders of the further facts that the men whose services have been dispensed with are still alive—some of them very much so; and that the makers of—let us say cornshellers, because those are not what the organization makes—makers that were formerly almost unheard of and were not considered worth getting into the combination, because they "cut no ice," have secured the services of these discarded men and find that it pays to employ them; while the organization finds that the establishments that were formerly negligible as competitors are now much more frequently heard from in that capacity. This results from the fact that there is, after all, a large element of personality in business affairs, and that a man who has thoroughly mastered the art of selling cornshellers can sell them, and can transfer trade from one manufacturer to another in such things or in any standard article which can be made about equally well by all who are engaged in the business.

From this the natural conclusion is that, sooner or later, the large company may have to face the question of buying up the outside manufacturing establishments, and when this comes to be done the price will probably be high—so high, perhaps, as to make the savings now being effected seem rather insignificant.

We understand, also, that some of the most successful manufacturers of cornshellers are not getting as good returns on their capital and for their labor as they received when conducting their business themselves in their own way, and that it is being shown that benefits so far accrue only to those concerns that were not doing very well previous to the formation of the combination.

We relate and thus comment upon these facts simply as a matter of interest, regardless of one's opinions as to the desirability or otherwise of large combinations rather than smaller separate establishments in competition with each other, and it is to be remembered, too, that present trade conditions do not permit of a thorough test of the final outcome of these affairs. This test will be made when times are not so good as now, and when orders must be actively sought for. It is a familiar fact that there are salesmen who can inspire and develop a demand for their products where none formerly existed, except perhaps in a dormant state, and that circumstance has a more important influence on trade than is often attributed to it.

Hand and Machine Labor.

The thirteenth annual report of the United States Commissioner of Labor, Carroll D. Wright, recently issued, is for the year 1898. This report embodies the results of an investigation authorized by a joint resolution of Congress inquiring into the effect of the use of machinery upon labor and the cost of production, the relative productive power of hand and machine labor, the cost of manual and machine power as they are used in the pro-

ductive industries, the effect upon wages of the use of machinery operated by women and children, and also whether changes in the creative cost of products are due to a lack or to a surplus of labor or to the introduction of power machinery. The results of the inquiry do not bear upon the last two items of the proposed investigation. The report represents a vast amount of labor in the collection, the condensation and the tabulation of data. Of the 1,600 pages of the report more than three-quarters are occupied by the tabulated statements of the various industries, practically the entire range of production, both agricultural and manufacturing, being included.

While the report is designed to bring into comparison the old-fashioned or hand processes and the most modern machine methods, showing the time consumed by the workmen and the cost of their labor for each operation under the two systems, it will be understood that the terms "hand" and "machine" are not used in the strict and narrow sense, as some machines were used in the hand methods and some hand work is not yet eliminated from our machine production.

There are also some extensive and important industries of the present day in which it was impossible to make comparisons with the old methods, as in the olden times these industries had no existence. There are various kinds of complex machinery peculiar to our day and unknown even a generation ago. The work of this machinery can, much of it, be compared with the same operations performed by hand methods, when, as in the sewing machine, it supplants the hand process, but the making of the machines themselves cannot be compared. The bicycle is a striking example of this class.

Another class of articles made or work performed which it was necessary to omit from consideration was that wherein the difference between the earlier and the later methods lies simply in the more thorough systematization of the work and the larger scale upon which the operations are now conducted. In each branch of industry, however, where comparison was possible, representative articles made under both hand and machine processes were selected as the subjects of investigation. The agents of the department then visited the large establishments engaged in their production and secured the data from the books and pay rolls of the firms. Personal inspection of each operation of production was also usually permitted. The effort was made to ascertain not the quantity of work which could be done under the most favorable circumstances, but what was steadily accomplished every day.

Much greater difficulty was experienced in securing reliable data for the hand production of the same articles. In some cases the article which is produced quite largely by machinery in the large towns or cities is still made by the primitive methods in rural and isolated communities. Often old employers or workmen long retired from active life had to be hunted up and the needed facts drawn from them. The data gathered were, as far as possible, submitted for verification or correction after their tabulation. All the data employed were, of course, obtained from American sources, except in the case of some of the hand operations, the information concerning which could not be obtained in this country.

It would be supposed that in comparing the old hand work system with that of the modern factory, articles of the two periods exactly alike would be selected. This was found to be an impossibility. Scarcely an article now in use is the exact counterpart of that serving the same purpose forty or fifty years ago, and the one in use to-day is usually superior to the one in use in days gone by. Plows made by hand differ much from the machine made plows of to-day. Wooden moldboards with plated points were made by hand, but these could not be found now. The fact that the plow made to-day is stronger, more durable, and better in all ways simply emphasizes the advance that has been made. If the added value of the articles now produced could be expressed in figures, the superiority of the modern over that of the past would be more strikingly shown, and the advantage exhibited in the figures of time and cost would be greatly magnified.

The work of production is carefully subdivided into the various operations involved, and those are each separately compared. The number of operations or steps of progress towards the completed article is usually considerably greater with the machine than by hand, but in some cases the reverse is true.

Interesting facts are disclosed in comparing the cost of an article in time and in money under the two systems. The labor cost of one plow by the hand method is $5.44, and by machine it is $0.79, the cost in time by the former method being 118 hours, and by the latter method 3¾ hours. In money cost the ratio of the past to the present is 7 to 1, and in time it is 31½ to 1. Many of the articles compared show results more extraordinary than this. The workmen under the old system received per hour the quotient of $5.44 divided by 118, or $0.046, and under the modern $0.21. While very much more has been gained in reducing the time needed to make an article than in lessening its money cost, yet the latter is seen to be now only one-seventh of what it once was. The explanation of the gain in time is to be divided between the inventiveness of the age and the stimulus of higher wages to the workman. It is to be remembered that the report has to do only with the actual labor cost of the articles dealt with, and does not include that of the administrative or clerical forces of the establishments.

It was, of course, a foregone conclusion that the showing must be continually in favor of machine work, or it would not so prevail, but the ratio of gain varies widely with the different items, it being sometimes very great and sometimes small. The saving of labor shown in agriculture as a whole is probably less than would be popularly expected. An average deduced from the twenty-seven units or different products reported upon shows that one man with the improved machinery in use to-day can cultivate and harvest nearly twice as large a crop as was possible under the primitive method.

When it comes to manufacturing, the difference is almost invariably greater. It takes sixteen times as long to produce a pitchfork by hand as by machine. In making plows the ratio is 31 to 1 in favor of the modern method; with wooden rakes the ratio is 12 to 1, and with steel rakes it is 6 to 1. In the making of boots and shoes the ratio ranges from 6 to 1 to 12 to 1 for the different styles. In tire bolts for wagon and carriage wheels a ratio of 750 to 1 is reached; this is not for the entire bolt, but only for the heading operation. For the whole bolt, however, as much is accomplished in one day as could be done by hand in a year. The greatest number of separately detailed operations seem to be in the manufacture of watch and clock movements, the work on certain parts of watch movements being enumerated to the number of about 110, and the ratio per thousand movements is 35 to 1.

It is not necessary to go farther into the results. The work seems to have been honestly done, and, as we have said, a vast amount of work must have been done, and doubtless the personal equation must in much of it demand large allowance, and the testimony of the report is, after all, merely a corroboration of what no one in this age can be ignorant of—that in everything we do we learn to do it easier and better as the years roll on, and we more completely compel the forces of nature to work for us.

Information Wanted Regarding the Adoption of the Premium Plan.

We are keeping a list of the various shops which are reported to us as adopting or making a trial of the premium plan. In several instances information of this kind has reached us through roundabout channels, and we are led to believe that the list is far from complete. We would, therefore, consider it a favor if our readers would inform us of any shops in which they may know the system to be in use. Any further information regarding the degree of success attending it, of peculiarities in its application, or of developments of any kind regarding it, will also be gladly received.

Commercial Review.

NEW YORK, Saturday, November 4.

DYNAMOS, MOTORS, ETC.

More than one seller of electrical apparatus has a fancy for plotting out the observed fluctuations of business in curves. We have before us an offhand sketch of the characteristic curves for lighting and other machinery drawn by a man who has paid considerable attention to this subject. One of the lines shown in the sketch is the characteristic curve for isolated lighting plants. Its contour is very much like that of the State of Virginia. Beginning low in the left-hand corner with the month of December, the ordinates which represent the relative amounts of business drop away to a minimum in January; then sweep upward with a long ascending line until, in August, a maximum is reached, after which they rapidly fall off. It may seem unreasonable to pronounce August the best month of the year, and probably there is a difference of experience in that connection; yet in the isolated lighting plant trade demand is, of course, active at about that time, because people are making preparations to install plants for the winter. The curve for the power line of business is flatter than that for the lighting, and the resultant for all lines would be somewhere between the two.

Now, a distinctive feature of the curve for the present year, as indicated by our informant, is that instead of a sharp decline as the end of the year approaches, there is only a gradual slope; in other words, trade is holding on toward the winter remarkably well. His report is borne out by other sellers, and, indeed, the indications in some quarters are that business is heavier than ever before.

The informal association started for the purpose of regulating and holding up prices to a reasonable figure, of which Mr. Campbell Scott, of the C & C Company is chairman, seems to be bearing some fruit. It is apparently in part as a result of this that several companies have recently announced a raise. The C & C Company last week put up its figures 10 per cent., making the third increase for the year. Some other quite prominent electrical companies having offices in this city have lately advanced, or expect shortly to advance, rates. The change made by one of these took place about a fortnight ago, and amounted to 15 per cent., which gives a total of 35 per cent. since the first of the year. In this particular case a marked falling off of orders has resulted. We understand also that the Westinghouse Electric and Manufacturing Company made a quite material advance, though not in the association.

The Manhattan Elevated Railway's contract for dynamos for its power house is liable to be closed at almost any time. The estimates thus far in are said to be for power plant equipment merely, not for motors for the rolling stock. It would appear from the nature of the case that the contract when awarded must go in bulk to one company and cannot well be divided between two, as asserted in a current report. Subsequent departments of the electrical equipment of the road are another matter.

The New York Light, Heat and Power Company has selected for its new generating station Westinghouse engines. The order calls for eight vertical engines of 5,500 horse-power each. The times for delivery are stated not yet to be settled.

The Metropolitan Street Railway Company of this city has just ordered of the General Electric Company about $40,000 worth of additional equipment, including one 300-kilowatt testing transformer, three exciter sets driven by induction motors of 230 horse-power each, etc.

The Bullock Electric Manufacturing Company has sold to the Philadelphia "North American" for its printing office, three 50 horse-power teaser motor equipments and one 100-kilowatt generator.

The C & C Electric Company reports having sold more electrical machinery in the last sixty days than in any previous six months. Orders are now being taken at prices which are better than have been obtainable for over four years. In fact, figures have reached a basis where they are pronounced fairly satisfactory. A cable order was recently received from England for twenty-seven motors of 2½ to 35 horse-power. Orders are on file for some fifteen machines of 2½ to 15 horse-power each, to be shipped to Buenos Ayres. A complete electric lighting plant has been ordered for Gautemala. Several small generating sets are being built for United States Government cruisers and transports. A contract is on file for motors to be used in connection with the heating and ventilating system of Cornell Medical College, New York, comprising some good-sized machines. The company is making fairly reasonable deliveries on small machines. Those under 30 kilowatts can be furnished in 30 days or less.

The Crocker-Wheeler Company will furnish a 200-kilowatt engine type generator for lighting a prison at Nashville, Tenn.

The Buffalo Forge Company, through its New York office, has received a contract for engines, fans, heaters, etc., for hot blast heating and ventilating of the new shop of the German Garvin Machine Company, Berlin.

Automobile supply is extensively engaging the attention of such of the electric motor manufacturers as cater to this line. The orders are coming in from a goodly number of horseless carriage builders, showing the distribution of that industry. The Columbia and Electric Vehicle Company ordered about 1,500 motors of the Siemens & Halske Electric Company of America a few months ago and are placing additional orders frequently. It is understood that there was a contract for 300 motors at quite a recent date. The Siemens & Halske Company is said to be turning out about twenty carriage motors a day. One of the electric companies which has not hitherto built carriage motors is now preparing to enter that field.

It is rumored that the M. S. Friede Company, 320 Broadway, New York, through whom a large quantity of tools and supplies was purchased earlier in the year for the Chinese Eastern Railroad, has on hand specifications for more of the same nature to a very considerable amount.

A concern located at Waltham, Mass., has just been incorporated by Messrs. F. C. Mann, D. F. Viles and A. E. Viles, with a capital of $5,000, for the manufacture of automatic screw machines. Its name is given as the Waltham Screw Company.

The Webster Manufacturing company has received an order for about $5,000 worth of power transmitting, elevating and conveying machinery for a cotton seed oil plant near Manaos, Brazil. Of other contracts recently closed by the company three amount together to about $40,000. Two of these are for equipping with their apparatus cement mills, one of which is being erected at Craigsville, Va., by a New York party, and the other at Manheim, W. Va., by a Philadelphian. The third of these contracts is for the complete equipment of a 300,000 bushel grain elevator at Nashville, Tenn. The company will also furnish the machinery for a 1,000,000 bushel grain elevator to be built at Chicago by their engineering department, John S. Metcalf & Co., for the Grand Trunk Railway. The Webster Manufacturing Company reports business exceedingly heavy. Gas engine trade is expanding, and competition growing keener. There is, however, a relative slackness in this line at the present season of the year. The company has lately shipped a gasoline engine to the Straits Settlements and one to Ponce, Porto Rico. The latter is a 6½ horse-power engine, and is destined for a cigarette factory.

The Ferracute Machine Company, of Bridgeton, N. J., whose exhibit at the Export Exposition has attracted much attention, has been the recipient recently of some quite extensive orders. To the Ordnance Department at the Washington Navy Yard it has recently shipped six presses and two cutting-off lathes for drawing the brass shells of the large cartridges from 2 inches up. From the General Electric Company it has received an order for one 26,000-pound press, 100 inches wide, two of 20,000 pounds and six of 12,000 pounds. These are for use in punching out armature disks and teeth, etc. Thirty-two presses are on order for the Star Ball Retainer Company, Limited, Lancaster, Pa., sixteen of which have been shipped. These are for punching and

forming ball retainers for bicycles, etc. Much of the product of the Ferracute Company goes abroad. The bulk of present foreign shipments is going to France and Germany, a lull occurring in the English demand. With the establishment of the large electrical factories now contemplated in Great Britain, the English business will shortly show great improvement. Large orders have also been received from Japan.

PHILADELPHIA NOTES.

Hess Machine Works, manufacturers of file-making machinery, report business as especially good. A peculiarity about the machines built by them is that ninety-nine out of every hundred go abroad, where file making has not so far been concentrated in few hands, as here. Several large blank grinding machines have recently been shipped to Vienna, and many regular file-cutting machines to England and Germany. They are at present engaged in the development of certain new and improved machinery for cutting the teeth of rasps, for which they expect an extensive call.

J. W. Cregar reports a steady demand for machine tools of every description; so well sustained that the space occupied by him at the Bourse has been almost denuded of tools by customers who could not wait for factory delivery. Mr. Cregar is handling the tools of a large number of manufacturers, and looks for no immediate falling off from the present condition of demand. He also reports a steady call for the lathe center grinder he has recently placed upon the market.

The establishment of a permanent machinery exhibit in the basement of the Bourse building has given to the buying public of Philadelphia and vicinity a convenient center of attraction. Its success has been such that almost all the spaces are filled, machine tools, gas engines, electrical apparatus, etc., being well represented; and Mr. T. Welsh, who has this in charge, reports demands for space more than he can conveniently handle. The delegates to the International Commercial Congress spent Pan American day at the Bourse, and under the care of Mr. G. E. Bartol, president of the Bourse, were piloted around the different sections. These delegates are learning a great deal about America by this actual visual experience, all of which should bear good fruit in the near future.

The works of the Southwark Foundry and Machine Company are operating under the fullest possible time schedule, and report no s bsidence of the demand for their high-speed engines, etc., nor yet any signs of a subsidence.

J. E. Lonergan & Co. are quite busy, a large part of their output going abroad. Forty thousand of their lubricators have been shipped to foreign countries, and a constant current of repeat orders from the same sources testifies to satisfaction with the goods already sent and to appreciation of American products by foreign customers.

So great is the rush of orders in the Otto Gas Engine Works that extension of the factory has become a necessity. A large and steady demand for Otto gas engines has arisen for the driving of electric plants; the excellent governing of the engines fitting them peculiarly to this employment. The works have orders on hand for several months, but with the extensions contemplated expect to be able to cope with them satisfactorily.

The Keller Tool Company, manufacturer of pneumatic tools, reports a growing demand for its product. Although this company is quite young, its shop is already crowded with work. The development of a full line of tools is going steadily forward, and Mr. Keller states that the outlook is distinctly encouraging.

The shops of Lucas, Gliem & Co. are also crowded and behind on deliveries. They contemplate expansion to take care of increased orders for the machine tools they manufacture, and look forward confidently to a steady demand. This is a young firm, but it has already made a good place for itself in the machine tool industry.

CHICAGO MACHINERY MARKET.

By way of shop supplies, one of the largest orders that seems to lie in the near future is that of the various bicycle plants comprising the American Bicycle Company. Most of these plants have sent out inquiries to the trade, asking for prices on quantities of supplies about equal to their last year's consumption, but none of these plants have yet ordered. It is conjectural whether each original company will order its supplies individually, or whether the entire business will be bunched and placed by the main office. If the latter, the aggregate will be of most respectable proportions. There is a pleasing outlook for the supply men, but the machine tool sellers are not indulging in any great hopes from the bicycle trade this year. The independent bicycle and bicycle parts manufacturers are giving heed to their position and trying to obtain their bearings in the industrial world. While the prices of crude iron and steel material have advanced, it is stated that the values of bicycle parts will be only a trifle, if any, higher than last season. Saddles, frames, seat posts, handle bars, etc., are listed now at just about the figures of a year ago.

And among other manufacturers than the independent bicycle makers are there signs of effort to obtain greater economy. The rapid advances in files, for example, are said to be stimulating the use of emery wheels where files had previously been used. Trials are being made to discover if in some instances malleable castings may not be safely substituted for drop forgings, on account of the swift appreciation in the values of the latter.

Concerning the volume of trade in machinists' supplies, it seems to be maintaining the standards of the past summer. There is less hurrah over the expansion, and the conviction is deepening among the trade that the activity has come to visit the land for quite a spell, and there is little prospect that it will wear out its welcome. The only grumbling heard is by a few factors at the high prices, but even the current values are accepted with equanimity by a majority of the trade. Machine shops are generally so busy that a stranger stands not a ghost of a show to get any work done promptly. If he can secure the intervention of a powerful intermediary he fares better, but so well are the shops filled with work, that they are turning down a large share of what is offered. Malleable castings are sold ahead for a year by some foundries. Relief locally is hoped for from several large new foundries, which are expected to be in operation in two or three months.

C. H. Besly & Co. are sold far ahead on their Gardner grinders, and their tap department is running full time. Armstrong Bros. Tool Company is selling more tool holders than ever before, and is scarcely able to keep even with its orders. Prices are unchanged.

Quotations.

NEW YORK, MONDAY MORNING,
November 6, 1899.

Iron—American Pig, tidewater delivery in 1900:—

Pennsylvania Irons:	
No. 1 X foundry	$24 65 @ $25 00
No. 2 X foundry	23 65 @ 24 00
No. 2 plain	22 90 @ 23 00
Alabama Irons:	
No. 1 foundry	23 25 @ 23 75
No. 2 foundry	22 25 @ 22 75
No. 3 foundry	21 50 @ 22 00
No. 1 soft	23 25 @ 23 75
No. 2 soft	22 25 @ 22 75
Foundry forge	20 75 @ 21 25

Bar Iron — Base sizes — Refined, mill price on dock, 2.25 @ 2.35c.; store price, 2.60c., upward; common from store, 2.50 @ 2.60c.

Tool Steel—Base sizes—Standard quality, 7 @ 8c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel—Base sizes—Ordinary brands from store, 2.90 @ 3c. in small lots.

Cold Rolled Steel Shafting—Base sizes—From store, 4c. in small lots.

Copper—For Lake Superior ingot, 16⅞ @ 17c.; electrolytic, 16¾ @ 16⅞c.; casting copper, 16¾c.

Pig Lead—Carloads, 4.62½ @ 4.65c.; wholesale lots, 4.60c.

Pig Tin—in 5 and 10-ton lots, f. o. b., New York, 30 @ 30¼c.

Spelter—Prime Western in carload lots, 4.90 @ 5c.

Antimony—In cask lots or over, Cookson's, 11 @ 11¼c.; Hallett's, 9¾ @ 9⅞c.

Lard Oil—Prime City, present make, ice-pressed, 45 @ 47c. in jobbing lots.

Indexing Multiple Punching Machine.

The accompanying half-tone and line engravings illustrate a remarkable machine for punching the parts of built-up columns, girders, etc., direct from the drawings and without templates or laying-out of any kind.

In the case of a box girder or a column built up of plates and channels, a row of accurately spaced holes must be made along each edge of the plates. The spacing of these holes may or may not be uniform throughout the length of the plate, and in the case of built-up columns additional rows of holes across the plate may be needed at the ends where brackets for the support of floor beams, etc., are to be attached. To meet these conditions the spacing of the holes in both directions must be adjustable.

The general construction and method of using the machine are best shown by the half-tone illustration, Fig. 1, in which a set of frames and guide rollers for supporting the spacing table, and located between the machine and the observer, is omitted, in order to disclose the operating mechanism.

A set of ten punches in a gang will be seen to be mounted on the ram, and in a line which is perpendicular to the spacing table and to its line of movement. These punches may be varied in number and in pitch to suit the work, and, by pulling an organ stop above each punch, it may be made inoperative at will.

In use, the long sheet to be punched is attached to the table, but overhanging it so as to lie on and to be drawn over the female dies below the punches. Heavy arms are bolted to and across the ends of the sheets, these arms extending also across the spacing table, and being bolted to it, so that the sheet is driven by the table and a given feed of the table is accompanied by a corresponding feed of the sheet under the punches. This spacing or indexing movement of the table is effected automatically by the machine itself, and is adjustable at will by the simple act of setting the index slide blocks which, with their vertical handles and latch levers, are seen at the right.

The operator stands at the right and within convenient reach of the index blocks and clutch lever above. He has before him a blueprint of the piece to be punched, and adjusts the pitch of the punches to suit the first row of holes. The plate being in position with one end below the punches, he closes the clutch and makes the first row of holes. Thereupon he adjusts the index blocks to give the distance to the next row, and pulls out some of the organ stops or not, as may or may not be necessary, and again closes the clutch. After the end holes for floor beam brackets, etc., are made, the organ stops are pulled for all punches except those for the rows of holes down the edges of the plate. Should the lengthwise spacing be now uniform, the clutch lever is held down, and the machine goes on punching and spacing until the clutch is opened. Should the spacing vary from time to time, the index blocks are adjusted as required; and should additional holes be required across the plate, the organ stops are pushed in as needed.

The range of the indexing movement is from zero to 8 inches, by sixteenths, and it is accomplished by a peculiar mechanism which is, we believe, entirely novel. One of its peculiarities lies in the fact that the movement of the table is the sum of the movements called for by two mechanisms, one of which indicates the whole inches only, while the second indicates the

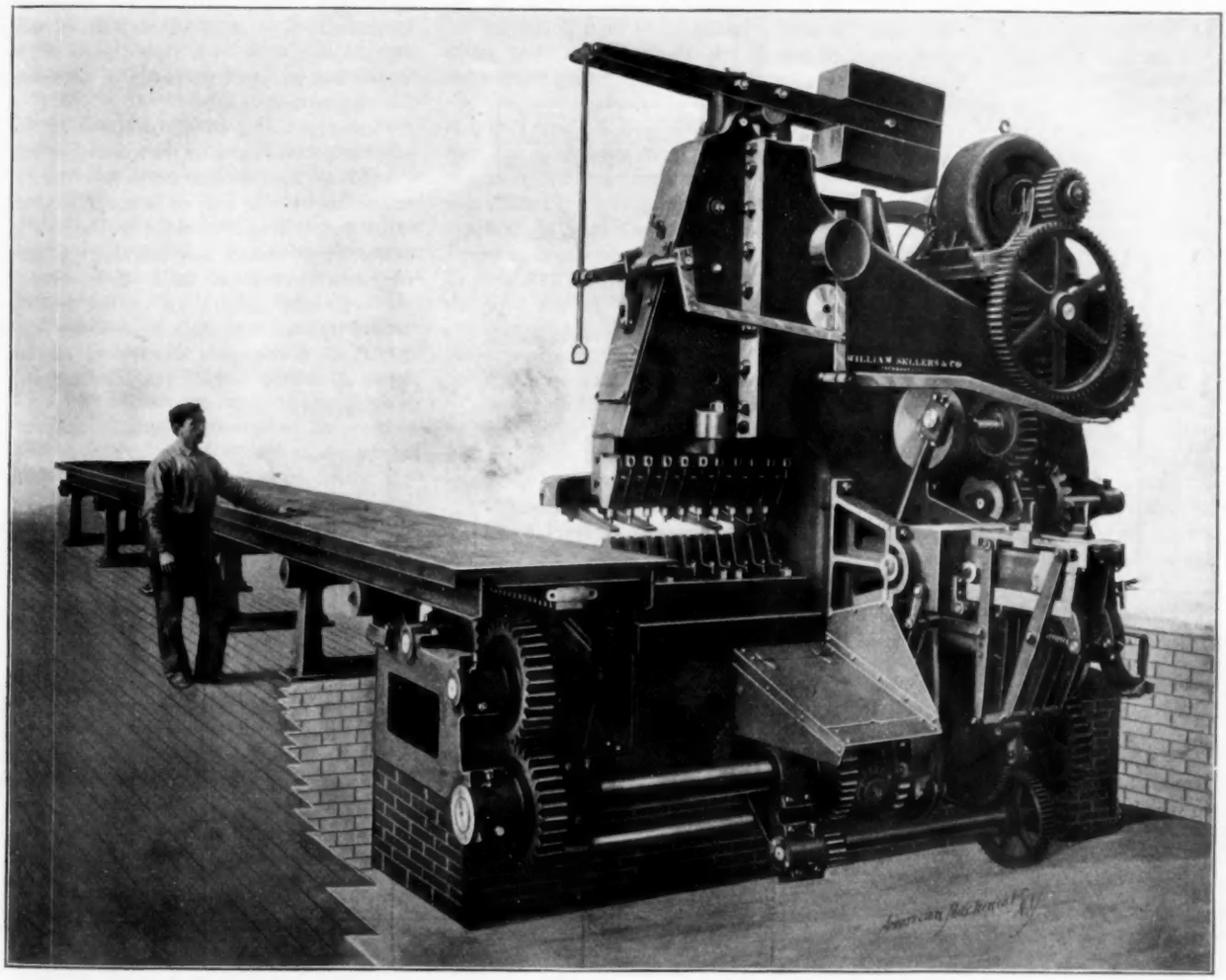


FIG. 1. INDEXING MULTIPLE PUNCHING MACHINE.

fractions. It is clear that a single indexing mechanism operating up to 8 inches by sixteenths would require 8 times 16, or 128, index notches, while the present arrangement requires but eight notches in one bar and sixteen in the other; that is, 8 plus 16, or 24 in all. Moreover, with a given pitch of the index notches the length of the index bar is but one-eighth of what it would be if the alternative arrangement were used. Another feature of the mechanism is that by which the movement of the parts which determine the spacing is done by the machine itself; the sliding block, which is adjusted by the hand, being an index only and entirely free from the mechanism when being adjusted. Still a third feature is an automatic brake whose office is to prevent the inertia of the heavy table from causing over-running. The movement of the table is accomplished in the same period of time, regardless of its length, a condition of things which requires a stronger application of the brake for large movements than for small, and this adjustable brake pressure is applied automatically by the machine. At the beginning of the movement of the table, its inertia puts considerable labor on the mechanism, and at this time it is obviously desirable that the brake pressure be released, and this again is done. At the beginning of the movement the table is entirely free from the brake, which is applied at about the middle of the movement, when retardation begins, and with a pressure proportionate to the length of movement. The indexing mechanism will thus be seen to be of a high degree of interest, and we shall endeavor to illustrate and describe it clearly.

Figs. 2, 3 and 4 are illustrations of the more important parts of the spacing mechanism. In Figs. 2 and 3, 1 is a vibrating segmental slotted arm or link, pivoted to the frame at 2 and operated by the link 3, driven by the crank 4, which turns in unison with the machine as a whole. From the segmental arm 1 hangs the link 5, which, through bell crank 6, operates pawl 7. Pawl 7 engages notches in ratchet wheel 8, through which the main spacing table is driven, the notches in 8 being so spaced that each one represents the smallest increment of movement of the mechanism. Link 5 is connected to a sliding block in arm 1, and the position of this block in the slot obviously determines the extent of the spacing movement. The adjustment of this block might be made by hand, but in a machine of this size this would involve a good deal of effort, and this is obviated in the following manner: Connected to arm 1 is a curved link 9, the opposite end of which is supported by a hanger 10, where it drives the link 11 and

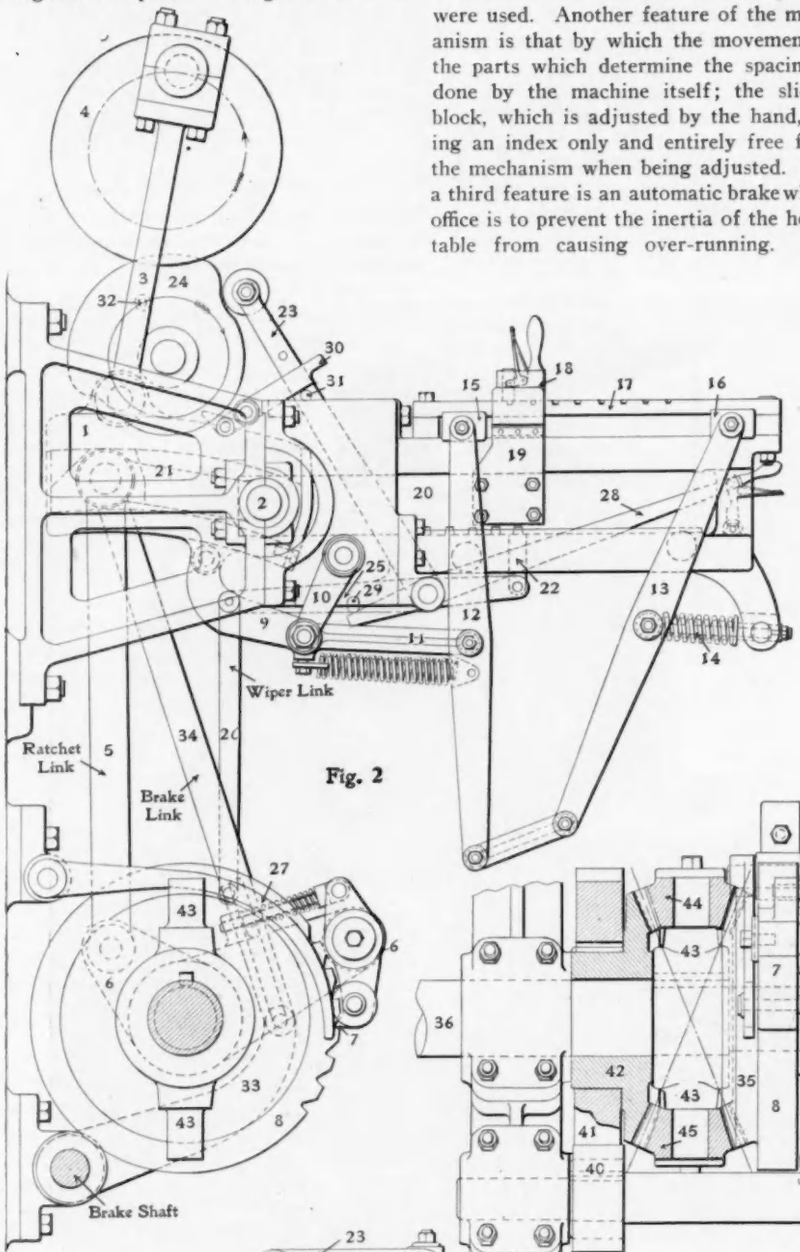


Fig. 2

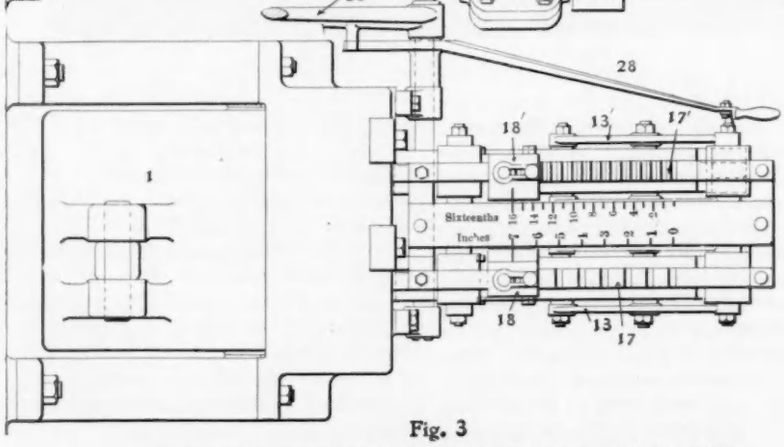


Fig. 3

INDEXING MECHANISM OF MULTIPLE PUNCHING MACHINE.

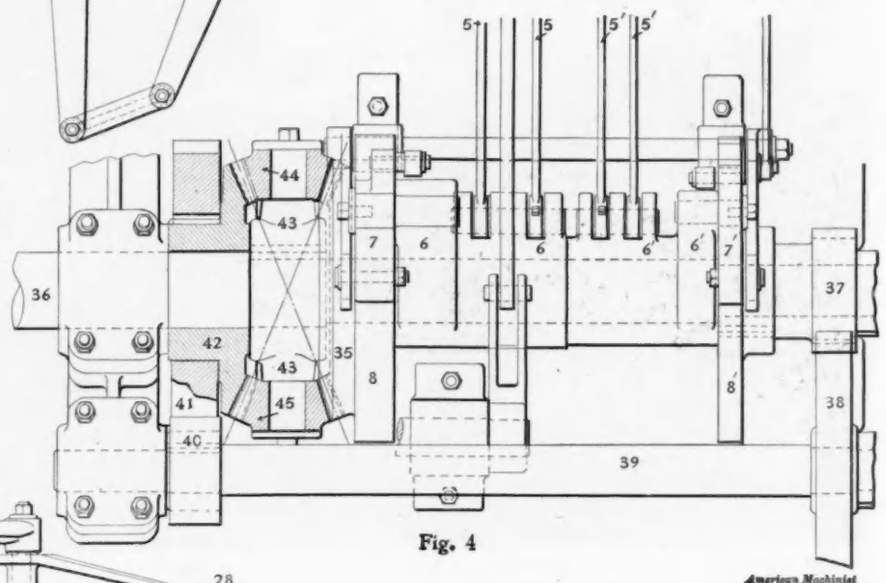


Fig. 4

through it the tongs 12, 13. Tong 13 is supported at its center by a spring link 14, and the upper ends of the tongs drive jaw blocks 15, 16, which slide in a guideway. In the movement of the machine it is clear that while the tongs alternately open and close, the minimum space between the jaw blocks at their closed position may be located at any point along the guide way—the position of this gap, as so far explained, being indeterminate. Above the guides of the jaw blocks is a notched index bar 17 with a sliding index block and latch pin 18. This block is of the minimum width of the space between the jaw blocks 15, 16, and wherever the index block be placed, the jaw blocks when closed will embrace it, since their position, so far as their driving links are concerned, is indeterminate. When, however, one of the jaw blocks engages the index block, the index block will form an abutment which will arrest further movement of that jaw block and its tong lever, while the other jaw block will thereafter approach the index block, finally stopping when it engages the block. In other words, the position of the index block determines the position of the jaw blocks and tongs when at their minimum distance apart. Below the index block is another block 19 attached to a sliding bar 20, which, by a link 21, connecting it to the block in the slot of arm 1, determines its position, and thus the extent of the movement of link 5 and of the spacing pawl. After one of the jaw blocks 15, 16 has come into contact with index block 18, its motion will be arrested, but that of the other will continue, and it will presently engage block 19 and push it ahead until it reaches a position directly below the index block, wherever the latter may be. The effort of the operator will thus be seen to be that necessary to move the free index block only, the adjustment of the machine being automatic. Links 11 and 14 will be seen to be provided with springs, the purpose of which is as follows: The spring below link 11 tends to swing the whole tong system clockwise, and thus to keep the jaw block 15 in contact with index block 18. By this means jaw block 16 leads 15 in opening and follows it in closing, this fixed sequence of movements being advantageous for the manipulation of index block 18. The purpose of spring 14 is to insure the closing of the jaw blocks against the index blocks, the actual movement of the jaw blocks being a little in excess of that required, and the excess being relieved by the springs.

In the position of the parts shown, the pawl 7 has completed its working stroke, and it will be noticed that the curved slot in arm 1 is now concentric with the pin at the lower end of link 5. This arrangement insures that the pawl always comes to the same position at the end of its working stroke, regardless of the length of that stroke. Consequently, the feed of the table is necessarily that due to an exact number of ratchet notches. There is thus no necessity for refined accuracy in the divisions of the index bar, the divisions of which may be such as to provide considerable over-travel of the pawl on the ratchet teeth. Another outgrowth of the arrangement is that lost motion in the link work, due to wear, does not introduce errors in the spacing.

The closing of the tongs locates block 19, but the opening of the tongs leaves this block free, and in order to secure it in position while the spacing is being done, notches are cut in the lower side of bar 20, and a latch bolt 22, operated by lever 23 and cam 24, serves to lock the block during the action of the spacing mechanism, but to unlock it as soon as the movement of the work table is complete. Should the next space repeat the last, the closing of the tongs will insure the repetition of the last index movement; but should the index block 18 have been changed in the meantime, sliding block 20 will be moved accordingly by the tongs, and be locked again in its new position by the latch 22. Lever 23 has a second arm 25 connected by link 26 to a shield 27, arranged to lift the pawl during its return stroke, and so avoid snapping over the teeth. This shield, however, has another and much more important office. Hand lever 28 will be seen to project under a lug 29 on arm 25, and by depressing the hand lever the shield will be raised and the action of the spacing mechanism be suspended at will without stopping the machine as a whole, and this hand lever is so used whenever the operator may find a stoppage desirable, to give ample time for indexing the next step. Having thrown the indexing movement out of gear by this action, it is obviously necessary that it be not thrown into gear again except at proper times—namely, during the return stroke of the pawl, since should it be thrown in during the acting stroke, a short and false step would be given to the work table. Consequently, a latch 30 is provided which drops behind the pin 31 when lever 23 is drawn back, and holds the lever in that position, even though the hand lever be raised, until released by the pin 32 on the rear face of the cam 24, and this pin is so timed as to insure the re-engagement of pawl 7 at the beginning of its working stroke.

The application of the brake to the table, whereby over-running is prevented, is by the arm 33 actuated by the link 34, which is connected with the sliding block in arm 7. The link 34 being connected to the sliding block in arm 1, its stroke varies with the indexing movement. At its lower end link 34 is slotted, so that a portion of its movement is idle. The pin on the end of arm 33 is so located that the end of the slot engages it at the middle of the movement of arm 1, when the motion of the table is about to become a retarded one, and the brake arm 33 being driven by the pin which determines the spacing, its movement is obviously proportional to the spacing movement. This movement of arm 33 applies the brake through the compression of a spring, and the compression of this spring being proportioned to the movement of the work table, the pressure of the brake follows the same law. This brake shoe, it should be remarked, is applied directly to the work table, so that any lost motion in the driving gearing of the table may not vitiate the accuracy of the spacing, since the table, being prevented from over-running, is also prevented from taking up the slack of the gearing.

There remains to be described the mechanism by which the whole inches and fractions are indexed separately, and the movement due to the two sets of indexing mechanism are added together for determining the movement of the work table. The vibrating arm 1 is, in fact, quite wide, as will be seen by Fig. 3, which is a plan view of Fig. 2, and has two curved slots, one at each side, for driving two index mechanisms. These two mechanisms are located side by side, as seen in Fig. 1 and also in Fig. 3, and up to and including the pawls 7 are duplicates, and in their ratchet wheels differ only in the spacing of the teeth. Of these the lower index bar in Fig. 3, or the one nearest the observer in Fig. 1, indexes the whole inches, and the other bar the fractional parts of an inch. If, for instance, a space of 4 5-16 inches is to be made, the operator places the lower index block of Fig. 3 at 4 and the upper one at 5, and the machine then proceeds to add the two movements together and give the required movement to the work table.

The mechanism which accomplishes this is shown in Fig. 4. The whole-inches ratchet link shown in Fig. 2, at 5, is given the same reference number in Fig. 4, the fractional link being designated as 5′. Both will be seen to be, in fact, double, to avoid canting tendencies. The whole-inches pawl is at 7, Fig. 4, and its ratchet is at 8. This ratchet is secured to bevel gear 35, mounted loosely on shaft 36, by which the work table is driven. The ratchet link for the fractional movement is at 5′, its pawl at 7′ and its ratchet at 8′. This ratchet is also mounted loosely on shaft 36, and has formed in one with it the pinion 37, meshing into gear 38, which, through shaft 39 and gears 40 and 41, drives bevel gear 42, also loosely mounted on shaft 36. Keyed to shaft 36 is a cross arm 43, which at each end carries a bevel pinion 44, 45, meshing with gears 35 and 42. Gears 35 and 42 and pinions 44 and 45 will be recognized as forming a "jack in the box" nest, and it is clear that the shaft 36 will be turned by either 35 or 42, and that should both of these gears be turned, either together or in succession, the shaft 36 will be moved by an amount which is half the sum of the movements of the gears. The gearing connected with the fractional indexing will be seen to be proportioned to reduce the movement of the ratchet in order to pro-

vide for coarse and strong teeth in the ratchet.

This machine may be looked at from three points of view: First, as a piece of engineering, or as furnishing a new and bold method of doing a given piece of work; second, as a mechanical achievement in accurate indexing under conditions where accuracy is essential but difficult of attainment; and third, as an exhibition of novel and ingenious mechanism. We confess we are at a loss to determine from which point of view it is worthy of the most admiration. It is worthy of remark, however, that the problem of accurately and adjustably spacing long strips of metal where each space is necessarily measured off from the end of the last one and where the weights here necessary are involved, and without accumulation of errors as the work goes on, is one which many would have said was not capable of satisfactory solution.

The machine is the product of William Sellers & Co. and has now been in regular use for some months at the Pencoyd Iron Works.

A Proposed Improved System of Hydraulic Piping—II.

BY WATER FERRIS.

AIR CHAMBERS.

The location and method of using these pressure reservoirs form the distinguishing feature of the system. At intervals along the pressure main are to be placed large vertical cylinders of boiler steel, which in ordinary plants will vary in size from about 2 feet diameter and 6 feet high to 4 feet diameter and 12 feet high. The main pressure pipe enters one of these cylinders on one side near the bottom, and leaves at the same level on the other side, continuing on to the next cylinder, and so on. At intervals around each cylinder near the bottom are tapped pipe connections leading to the various hydraulic machines in the neighborhood of this cylinder or pressure reservoir, and each reservoir must be large enough to supply the machines to be connected to it. It will do no harm to have the reservoirs larger than necessary.

Fig. 3 shows the construction of one of these reservoirs, and its dimensions, under certain assumptions as to the work it will have to do. It is to hold in reserve enough water to supply the three machines drawing from it, with cylinders of the following sizes:

1 Cylinder	8 in.	diam.,	4 ft	Stroke, Volume	1.39 cu ft.
1 "	8 in.	"	4 ft.	" "	1.39 "
1 "	18 in.	"	1½ ft.	" "	2.66 "
				Total Volume, - - -	5.44 cu. ft.

Let us suppose that these cylinders may possibly all operate at once, and abstract this volume of water in about three seconds, or about 1.83 cubic feet per second. Let it also be required that this sudden draft of water shall not reduce the pressure in the reservoir more than one-twentieth of the initial pressure, or 25 pounds per square inch on a 500 pounds system. It is then also necessary that the main from the accumulator shall convey to this reservoir 1.83 cubic feet of water per second when the pressure is 25 pounds lower at the reservoir than at the accumulator. This last condition is necessary to prevent drawing the water any lower in this reservoir, after the pressure has already fallen to the lower limit of 475 pounds.

The condition regarding fall of pressure makes it necessary to have in the reservoir a volume of compressed air about twenty times as great as the volume of water which may be abstracted; because the absolute pressure of the confined air is inversely as its volume. If we have 5.44 cubic feet of water to be withdrawn, and a volume of $20 \times 5.44 = 108.8$ cubic feet of compressed air above it, at an absolute pressure of $500 + 14.7 = 514.7$ pounds per square inch, the pressure after the water is removed will be:

$$\frac{x}{514.7} = \frac{108.8}{108.8 + 5.44}$$

or $x = 490$ pounds absolute, or 475.3 pounds gage pressure.

The sizes of a reservoir fulfilling this condition are given in Fig. 3. A margin of 6 inches is allowed between the low water level and the top of the main, to provide against the possibility of the mains taking in large air bubbles during surging or splashing of the water. The material is ¾ inch steel boiler plate, with convex flanged steel heads. The vertical seam should be a triple riveted butt joint, with two cover plates. The girth seams at heads should be double riveted. A manhole is provided in bottom head to give access for riveting. This hole should be flanged inward, or else be reinforced. The pads for connecting to the mains may be either steel or iron castings, but should be flanged, not threaded. On large shells a thorough inside calking will make them tight. On shells under 30 inches diameter it is better to rivet the pads on with a sheet of ⅛-inch copper between pad and shell, and calk this sheet and the rivet heads on the outside. A cheaper construction may probably be devised for these reservoirs. As shown, they would cost from $200 to $400 each, according to the facilities used and the number made. In addition to the pads already noticed, holes are to be tapped for branch pipes to machines, several gage cocks, and the inlet and outlet air pipes. The inlet air pipe enters anywhere, preferably above the water level. The outlet pipe must leave the tank at the highest water level.

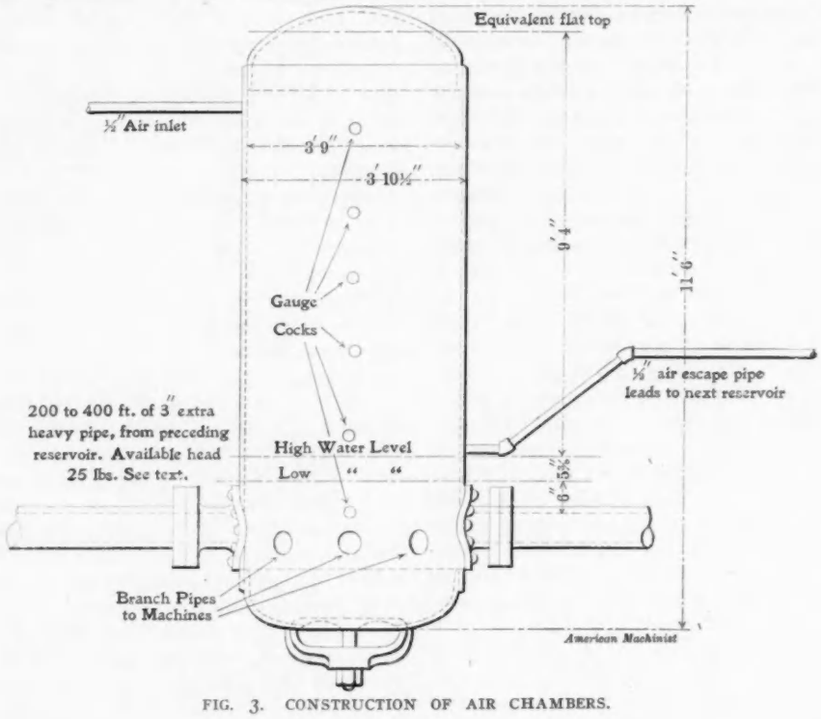


FIG. 3. CONSTRUCTION OF AIR CHAMBERS.

In addition to these pressure reservoirs there are a number of common air chambers to be located in the return pipe system, to take up the shock of sudden exhausts and receive the volume of water suddenly thrown out. They thus prevent the return mains from becoming gorged, and working under a heavy back pressure.

SIZE OF MAIN.

To determine the size of the main pressure pipe leading from the pump to this reservoir, we must have a good deal of information, or make assumptions, in regard to the particular plant and the location of the reservoir; that is, whether it is the nearest to the pump or the farthest from the pump, or intermediate. If farthest from the pump, no water goes through it to supply other reservoirs, and it is only necessary to compute the size of pipe re-

quired to supply it with 1.83 cubic feet of water per second, under a head corresponding to 25 pounds fall of pressure, or 57.6 feet. From the usual formulas for velocity and quantity, I would estimate that for a pipe 400 feet long, 5 inches extra heavy would be large enough.

If the water for other reservoirs must pass through this one, some estimate must be made of the largest *probable* demand at any time, and the pipe made large enough to supply it.

ARRANGEMENT AND OPERATION OF PLANT.

Referring now to Fig. 4, we have a diagrammatic sketch of a plant, combining the details already described. For the sake of clearness, the pressure system is shown entirely above the floor line, and the return systems entirely below it. P is the main pressure pump, p the small air pump shown in Fig. 4, attached to the main pump, and A the accumulator. T_1 and T_2 are pressure reservoirs; m_1, m_2 and m_3 are machines drawing their water supply from these reservoirs, and t_1 and t_2 are air chambers in the return pipe, to cushion the exhaust from these machines. At m_0 is shown a machine so close to the accumulator as to require no reservoir, and t_0 is its air chamber in the return pipe. T is the suction tank for the pressure pump.

It will be seen that the water pipe may be run in any convenient way, just as in ordinary practice; the only difference being that machines are usually supplied through branches from the reservoirs, and exhaust into air chambers. These latter, it may be well to note, may be of the cheapest convenient construction. A cast-iron base with tapped or flanged inlet and outlet for the main return, and inlets from machines, and with a 12-inch pipe, 4 to 5 feet long, screwed into it and the top capped, will be satisfactory.

The course of the air needs a more careful examination. As remarked in the article already referred to, the air pump must be located a few feet above the suction water level, to insure its satisfactory working; and the caution already given in this paper, as to the relative sizes of the two pipes from the main pump to the air pump, must be carefully observed. When the plant is started up, the air caught in a reservoir such as is shown in Fig. 3, on a 500-pound system, will be compressed into a hight of about 3½ inches at the top of the reservoir. Then the air pump feeds in more air, and gradually forces the water down below the level of the air outlet pipe, when the surplus air will pass out and on to the next reservoir, repeating the process there. In this way one reservoir after another is filled with air down to the high water line. After the last reservoir is filled, it is necessary that the surplus air should escape just fast enough; not so fast as to allow the water to rise and fill the reservoir, and not so slowly that the air will push the water level down and escape into the main, thereby displacing the reserve water which the reservoir is intended to retain. This may be accomplished by having a larger water space in this reservoir, so that after the water level has fallen as far as it will be required to fall to supply the machines, it may fall several inches farther before reaching the top of the water main. A float f is placed in the reservoir, connected to an air-escape valve v, which, when open, releases the air into the air-escape pipe line l_4, which leads to the first one of the air chambers in the return pipe. The float is so adjusted that during the ordinary fluctuations of water level it does not open the valve; but if the level is pushed down by an excess of air, so that the fluctuations carry it below the lower limit, the escape valve is opened from time to time to let the excess air out.

This air then passes into the first air chamber in the return pipe, and pushes the water level down until the top of the return pipe is reached, when the air is carried out in bubbles by the current of return water, until it comes into the next air chamber. Filling that and all the others in turn, it finally escapes from the surface of the water in the suction tank T. In this way these air chambers are always full and ready to do their very important work of equalizing the pressures and flow of water through the return pipe. I have already called attention to the excessive back pressure that occurs when no escape is provided for the rush of exhaust water.

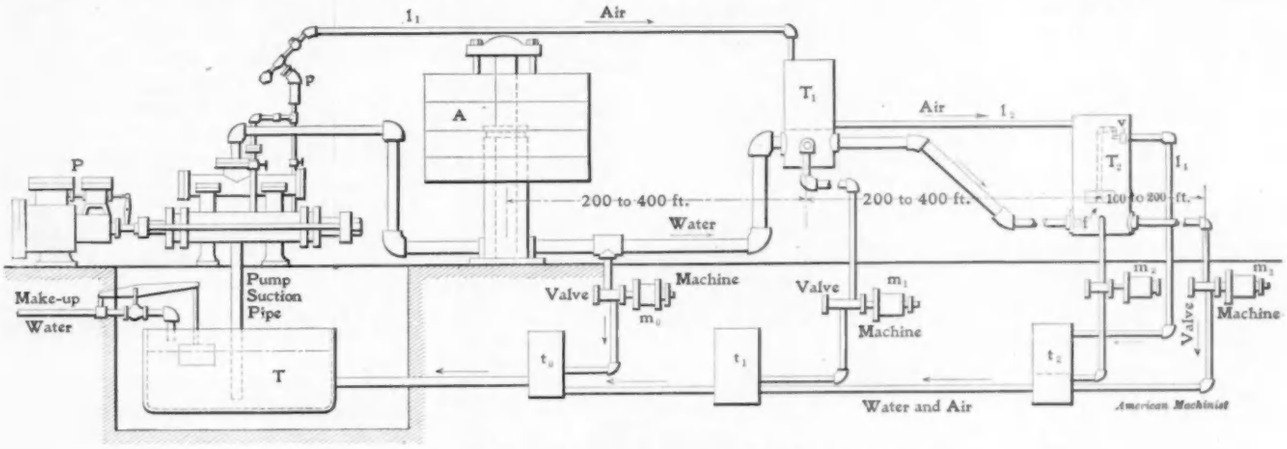


FIG. 4. HYDRAULIC PLANT, WITH AUXILIARY RESERVOIRS.

A Method for the Representation of the Circle in Isometric Projection and in Cavalier Perspective.

BY J. ERNEST G. YALDEN.

It has been frequently remarked that the great difficulty in isometric projection is the drawing of circles when they occur. Much of this is due to the fact that all text books on the subject solve the problem in much the following manner, quoting from one of the latest and best books on "Theoretical and Practical Graphics," by Professor Willson: "To draw circles and other curves isometrically, employ auxiliary tangents and secants, obtain their isometric representations, and sketch the curve through the proper points." (See Fig. 5.) It not only takes a good draftsman to do this well, but, what is of more importance, it takes too much time. The isometric projection and the cavalier perspective of a circle, when the plane of projection is not parallel to that of the circle, is an ellipse. The usual method is to circumscribe a square about the circle, and then, in the isometric projection of this square, which will be a rhombus (see Fig. 2), to draw the ellipse. By the principles of projection the middle points of the sides of the rhombus will be the points at which the ellipse representing the inscribed circle will touch those sides. Hence four points of the ellipse are easily found, the other necessary ones may be found by the use of tangents and secants isometrically projected.

The isometric and cavalier projections of circles have all the same relative eccentricity, and the ratio is such that for all practical purposes an approximate ellipse composed of the arcs of circles will answer to represent the true ellipse. This fact gives at once, if the centers of those

arcs can readily be determined, a rapid and effective method of constructing the curve. The difference between the correct and the proposed approximate construction may be seen at the top of the cube in Fig. 5, the full line being correct and the dotted line approximate.

I submit the following problems, which are capable of solution with the ordinary draftsman's tools, *i. e.*, 60-degree and 40-degree triangles and compass; and which do away at once with the necessity of the circumscribing squares and rhombuses, and the tedious location of points through which to sketch the required curve.

By referring to either Figs. 1 or 2, it

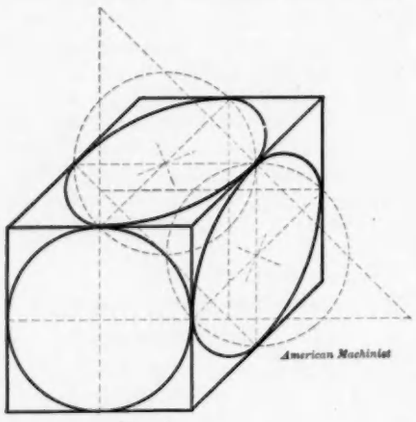


Fig. 1

CAVALIER PROJECTION OF THE CUBE.

will readily be seen that the problem consists in finding the centers of four arcs tangent respectively to the sides of a rhombus at their middle points. By these constructions it is not necessary to ascertain the major or the minor axes of the resultant ellipse:

Problem I.—To draw the cavalier projection of a circle, given its center and ra-

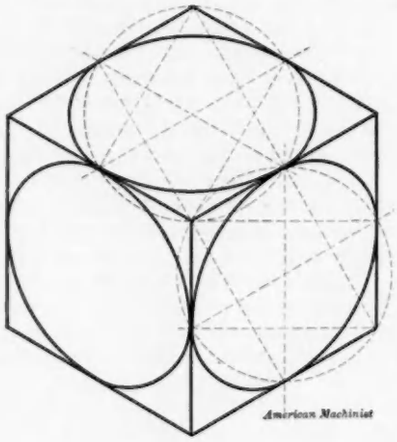


Fig. 2

ISOMETRIC PROJECTION OF THE CUBE.

dius, in the right-hand vertical plane. Draw a vertical line *A B*, Fig. 3, through given center *O*, and draw a circle with the given radius. Through *O* draw *C D*, making with *A B* an angle of 45 degrees. Points *A D B C* on the ellipse are thus determined. Through *C* draw *C G* at 90 degrees to *A B*, and through *B* draw *B H* at 45 degrees to *A B*. Likewise through *D* draw *D H* at 90 degrees to *A B*, and through *A* draw *A G* at 45 degrees to *A*

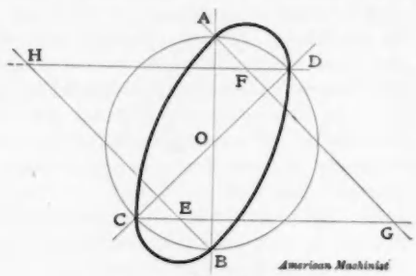


Fig. 3

CONSTRUCTION OF APPROXIMATE ELLIPSE—CAVALIER PROJECTION.

B. The intersections of these four lines form a rhombus the vertices of which are the centers of the arcs forming the approximate ellipse. The projection in the horizontal plane has the same construction, but on a different axis.

Problem II.—To draw the isometric projection of a circle, given its center and radius, in the horizontal plane. Through center *O*, Fig. 4, draw a line *A B*, 30 degrees from the horizontal, also *C D*, mak-

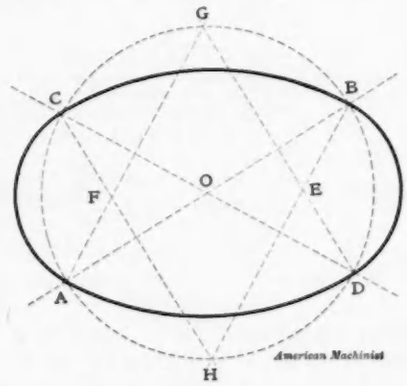


Fig. 4

CONSTRUCTION OF THE APPROXIMATE ISOMETRIC ELLIPSE.

ing same angle with the horizontal. With point *O* as a center, and radius equal to that of given circle, draw a circle. Points *A C B D* on the ellipse are thus determined. Through *C* draw *C H*, making 60 degrees with the horizontal, and through *A* draw *A G*, making same angle with horizontal. Likewise draw *B H* and *D G*. The intersections of these four lines form a rhombus, the vertices of which are the centers of the arcs forming the approximate ellipse. The other cases, either the right or left-hand vertical plane projections, are exactly similar constructions, but on different axes.

In general, cavalier perspective has one distinct advantage over isometric drawing, and that is that one side of the object is taken parallel to the plane of projection, and so all curves on that side are drawn as they actually appear.

Baron de Hirsch Trade School, New York.

Steel Foundry Cold Saw.

The accompanying half-tone illustration shows the largest cold saw cutting-off machine so far made in this country, and probably in the world. Its office is to cut off the risers from large steel ingots and castings, and it is not only of great size as regards capacity, but also of great power for heavy cuts.

The illustration is from a photograph

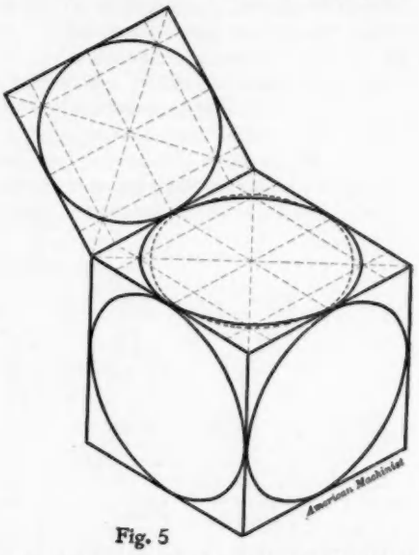


Fig. 5

THE TRUE ELLIPSE AND THE APPROXIMATE ELLIPSE.

taken while the machine was standing on the floor of its builders. As erected for use it stands on a heavy T-slotted floor plate made by the users, and of 10 feet width by 30 feet length, to which the work is bolted down. The traverse of the machine lengthwise of the bed is obtained by the screw seen running down the center of the bed and the cone pulleys at the end of the machine. The driving power is carried through the horizontal shaft at the base of the machine, the nest of gears connecting it to the vertical shaft, the steep pitch worm gear, and the large spur gear on the end of the saw arbor. The feed is vertical of the saw arbor. The vertical feed and quick traverse for position are obtained very neatly. The feed is obtained by the small gears on the face of the saw head, which obtain their motion from the large spur gear, and act by revolving a sleeve nut meshing with the vertical screw. For quick vertical traverse the screw is revolved through the prolongation of the vertical shaft and the gears above. Connecting the vertical and horizontal shafts at the top of the machine is a jack-in-the-box gear fitted with clutches which are thrown into or out of mesh by the hand-

wheel operating on the vertical screwed rod alongside the vertical shaft. The direction of the movement is obviously determined according as one or the other clutch is thrown into engagement. It will be noticed that both screw and sleeve nut are operated by worms, and that if the nut is in action the screw is locked in position by its worm; while if the screw is in action, the nut is similarly locked. At the same time it is clear that both gears may be in action at the same time without damage resulting. The pilot wheel mounted in line with and at the rear end of the saw arbor is for the lateral adjustment of the saw.

Unfortunately, there is no man or other familiar object in the picture to serve as a scale of dimensions, and the illustration does not on that account convey an adequate idea of the size of the tool. The following list of a few leading dimensions will, however, assist in forming an idea of its magnitude:

Diameter of saw—50 inches.

Diameter of spur gear on saw arbor—54 inches.

Diameter of saw arbor—11 inches.

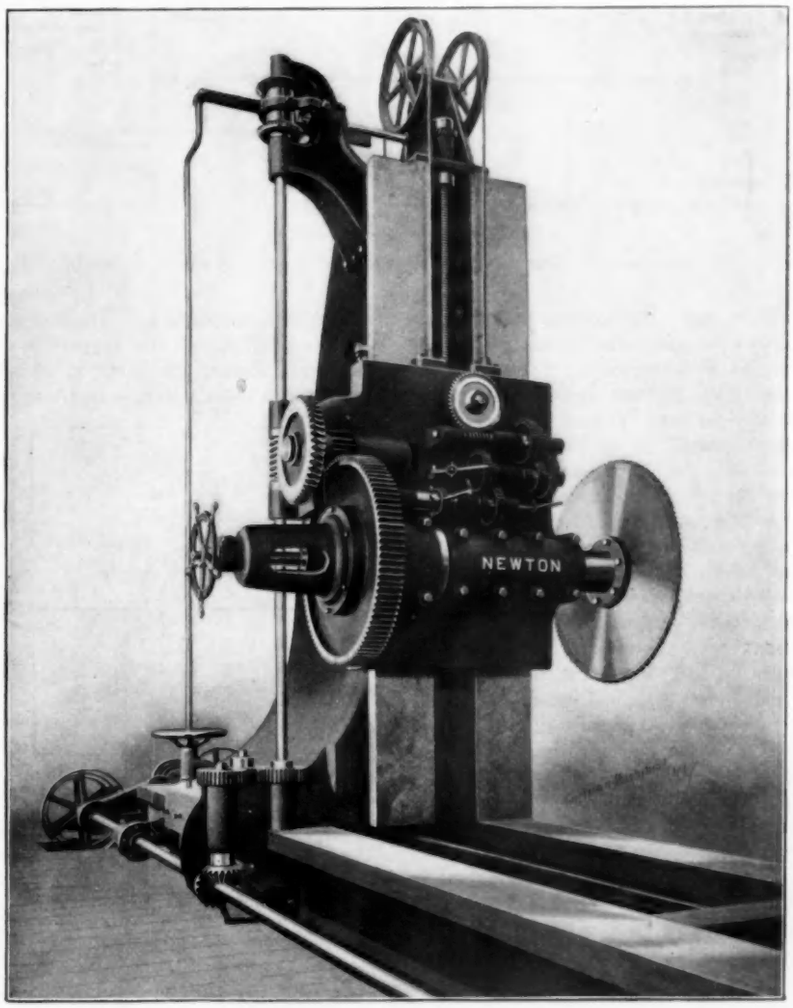
Adjustment of saw endwise of arbor—30 inches.

Vertical traverse—8 feet.

Horizontal traverse—20 feet.

Gross weight without floor plate—100,000 pounds.

The machine was constructed for the Bethlehem Steel Company by the Newton Machine Tool Works.



A STEEL FOUNDRY COLD SAW.

The Intercooler on the Air Compressor.

BY FRANK RICHARDS.

The two-stage air compressor without an intercooler is an absurdity, and has no mechanical excuse for its existence. There is economy in two-stage (and for the higher pressures more than two-stage) compression when the intercooler reduces the volume for each succeeding compression. The value of the intercooler on the two (or more) stage air compressor depends entirely upon its efficiency. It is important, therefore, to know as accurately as may be, what the efficiency of the intercooler is under the various conditions which occur. It is not, however, as easy as it might at first be thought to be, to determine the efficiency of an intercooler in any case. If there was a constant flow of air into the intercooler at an ascertained temperature and pressure, and a delivery as constant at another temperature, with or without some change of pressure, then the determining of the efficiency would be a simple matter; but such simple and constant conditions never occur. The flow of air through the intercooler is always intermittent, instead of constant, and both the temperature and the pressure of the air on either side of the intercooler go through a series of fluctuations with each rotation of the compressor shaft, or with each complete cycle of operation of the compressor. It is, of course, possible, by the use of the indicator, to ascertain the air pressure at any point and at any time; but it is impossible to ascertain instantaneously the temperature of the air, and this inability not only leaves us in ignorance of the temperature changes, but it also seriously impairs the value of the pressure record, as it is not with air as it is with steam, that the pressure practically guarantees the temperature. Our recent familiarity with liquid air has taught us to realize that our normal atmospheric air, and the air which we always deal with in the compressor, is highly superheated, and it is to this we owe it that the temperature and the pressure are not constant the one to the other. The most accurate information that we can obtain, by the indicator or otherwise, as to the air pressure anywhere as it is passing through the compressor carries with it at best nothing more than inferential and approximate evidence of the temperature, and for even this it is necessary to know with some accuracy either the initial air temperature or its temperature at some other determined point of its course. This lack of a practical instantaneous thermometer for use in connection with the indicator hampers the engineer in many of his investigations, and has had much effect in preventing a knowledge of intercooler efficiencies.

With the ratio of capacity of the cylinders of a two-stage air compressor which usually prevails, say 1 to .4, or 1 to .35, the delivery of air from the first, or low pressure, air cylinder does not begin until the piston has reached or passed the middle of the stroke, so that until this point of the stroke is reached none of the air compressed at that stroke is driven through the intercooler and into the other cylinder by the low pressure piston, and the propulsion forward of the air must, of course, cease with the end of the stroke, so that the intercooler has less than one-half of the total time in which to do its work.

There is quite a difference in the action, and some also in the efficiency of the intercooler upon the tandem-compound and that of an intercooler upon the cross-compound machine, the presumption being usually in favor of the latter.

Fig. 1 is a crude sketch of the arrangement of the essential parts of a tandem

two-stage (in this case single acting) air compressor, and Fig. 2 is a sketch of the corresponding parts of a cross-compound compressor. In each sketch *A* is the low-pressure cylinder, *B* is the high-pressure cylinder, C is the intercooler, *D* is the low-pressure piston, and *E* is the high-

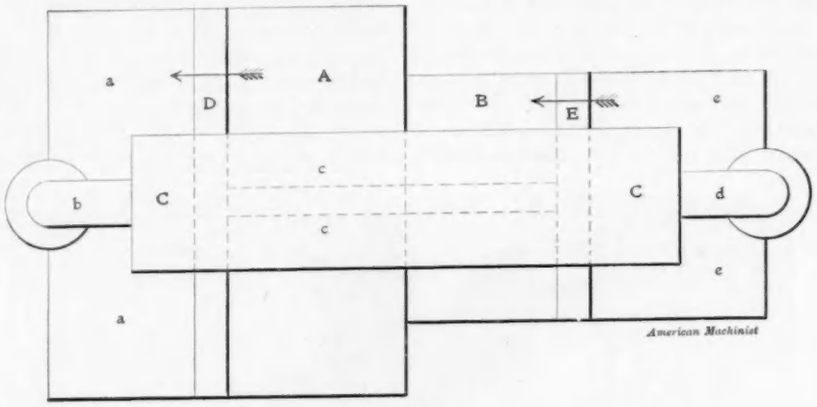


Fig. 1

INTERCOOLER ARRANGEMENT ON A TANDEM COMPOUND AIR COMPRESSOR.

pressure piston, the arrows indicating the direction in which the pistons are moving. The low-pressure piston in each sketch being in the position at which delivery to the low-pressure cylinder begins, the entire volume of air between the low-pressure and the high-pressure pistons is thereafter in motion at once, and continues in motion until the end of the stroke of the low-pressure piston. The body of air thus in motion consists of *a a*, that contained in the low-pressure cylinder in advance of the piston; *b*, in the passage between the low-pressure and the intercooler; *c*, the contents of the intercooler; *d*, that in the passage from the intercooler to the high-pressure piston, and *e e*, the portion of the high-pressure cylinder behind its piston. In this body of air in either sketch the volumes of *b*, *c* and *d* are constant, while the volumes of *a* and *e* are changing. In Fig. 1 the two pistons move always together and at the same velocity. In Fig. 2 the pistons do not move together, the cranks with which the two pistons are respectively connected being assumed to be 90 degrees in advance or behind each other, the connecting rod effect being here ignored. The velocities of the two pistons are, therefore, constantly (but not uniformly) varying, both relatively and absolutely. That of the low-pressure piston is diminishing during the whole of the time of the air delivery, while the velocity of the high-pressure piston is accelerated for the same period. It will be seen that in Fig. 1 the volume of air upon which the low-pressure piston is acting is constantly diminishing, as the portion of the high-pressure cylinder which is opened by the retreat of its piston is only .4 of the portion of the low-pressure cylinder which is cut off by the advance of its piston. When the air pressure in the low-pressure cylinder, then, has risen high enough for delivery to begin, the air is not then delivered for the rest of the stroke at that uniform pressure, but the pressure must continue to rise until the end of the stroke. At the beginning of the delivery, or when the pistons are in the positions shown in Fig. 1, it will be seen that the air at *d* and also that at *e e* has already passed the intercooler and can be no further cooled by it, while the compression of this portion is still to some

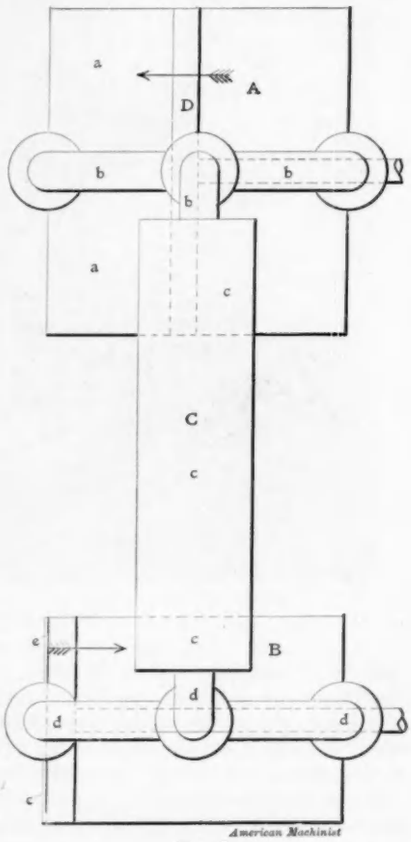


Fig. 2

INTERCOOLER ARRANGEMENT ON A CROSS-COMPOUND AIR COMPRESSOR.

extent going on, and the volume on the wrong side of the intercooler is increasing by the continual retreat of piston *E*. However efficient, therefore, the intercooler may be, it cannot fully cool all of the air for any stroke, because some of the air will have passed through and beyond it before compression ceases.

In the case of the cross-compound machine, Fig. 2, quite a different state of affairs exists. Here at the beginning of the air delivery the space *e e*, filled with air which has already passed the intercooler, is much smaller than the corresponding space in Fig. 1, and while the velocity of piston *D* is decreasing as before until the end of its stroke, that of *E* is increasing for the same period. The velocity of *E* is at first less than that of *D*, so that the decrease of total volume between the pistons and the consequent rise of pressure is then more rapid than for the same period with the tandem machine, but equal velocity is soon reached, and some time before the stroke of the low-pressure piston is ended the high-pressure piston is going so much faster that it more than makes up for the difference of piston area, and the volume of air between the pistons is actually increasing. The sketch shows the position of the low-pressure piston when its crank has gone 9 degrees, or one-twentieth of a half-revolution beyond the middle of the stroke, and when the crank of the high-pressure piston has gone 9 degrees past the center returning. The low-pressure crank will then have nine-twentieths of its revolution to complete its stroke, and the same movement of the other crank will bring the high-pressure piston to the middle of its stroke. The relative movements of each piston for each 9 degrees to the completion of the air delivery will be as follows, the total length of stroke being 1:

	Low Pressure Piston.	High Pressure Piston.
(1)	.076	.019
(2)	.073	.03
(3)	.067	.041
(4)	.06	.051
(5)	.051	.06
(6)	.041	.067
(7)	.03	.073
(8)	.019	.076
(9)	.006	.079

Here it will be seen that the velocity of the high-pressure piston is greater than that of the low-pressure when the fifth period is reached, and for the seventh period and beyond the velocity is so much greater that the enclosed volume of air, as was said, is enlarging instead of diminishing, and the pressure is consequently falling instead of rising. The delivery of air by the low-pressure piston, of course, ends with the completion of its stroke, and when the high-pressure piston has only reached the middle of its stroke. As here the delivery valves of the low-pressure cylinder close, and communication from one cylinder to the other ceases, the high-pressure cylinder is filled for the other half of the stroke by the expansion of the air in the receiver and passages in

connection with its own partial contents, and the pressure is therefore gradually descending. The indicator cards from air compressors show these fluctuations of pressure, but the range of them depends upon the capacity of the intercooler and passages. If these are large the rise and fall of pressures is comparatively small, and *vice versa*. It is therefore quite desirable to have a large intercooler capacity, entirely independent of and beyond the requirements for cooling surface. In Fig. 2 it is quite evident that the volume of air which undergoes any compression, and which consequently requires any cooling, is much smaller than in Fig. 1. At the beginning of the operation of compression in a two-stage compressor of course not all the air that is compressed in the first cylinder is delivered into the second, a portion of it remaining to make up the average pressure in the receiver and passages, but when this required average pressure is attained then the last cylinder receives, stroke for stroke, as much as passes the first cylinder. As the fluctuations of pressure in the receiver and passages of the cross-compound machine are usually less than in the tandem machine, and as the highest pressure occurs when but a small portion of the air for that stroke has passed the intercooler, it may be inferred that the efficiency of the intercooler, other things being equal, is greater than in the tandem machine. From the suggestions here offered it is evident that the problem of the intercooler on the air compressor is not a simple one.

Electrical Switches—III.

BY WM. BAXTER, JR.

In some cases the construction of switchboards can be simplified and cheapened to a considerable extent by the use of what are called multiple-point switches. We will first illustrate the application of such switches and then explain their construction. Suppose we have a small plant consisting of one generator which is required to feed into several circuits for supplying lights and a few motors, and let the conditions be such that we are not particularly concerned whether the circuits are entirely independent or not, so long as we can turn the current into any one circuit whenever desired. Let such a system be represented by the diagram Fig. 28, in which G represents the generator and a, b, c, d, e, f, six circuits, the arrangements being such that the current is only used in one circuit at a time. It will be evident that under these conditions, if the lower wires of the six circuits are all connected and run to the bus P', while the top wires are run independently to the six contacts of the switch S, the current from bus N' may be diverted to any one of the circuits by simply connecting N' by means of the wire m with the blade S' of the switch. If we desire to use the current in circuit d we turn S' to make contact with 4, and then the current will pass to circuit d, and from the lower side r will run to wire w, and thus back to P', and to the generator. The objection to this arrangement is, that a defect in the insulation of one of the circuits would in all probability disable the entire system. As the lower sides of all the circuits are connected with wire w, the grounding of any one of these sides would disable the whole system if there should be a ground in the generator or in the N wire through which a short circuit could be established. If the several circuits were connected with the buses N' P'

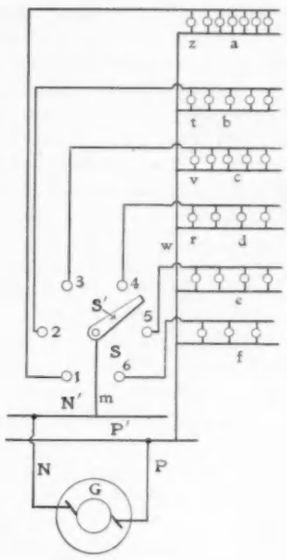


Fig. 28

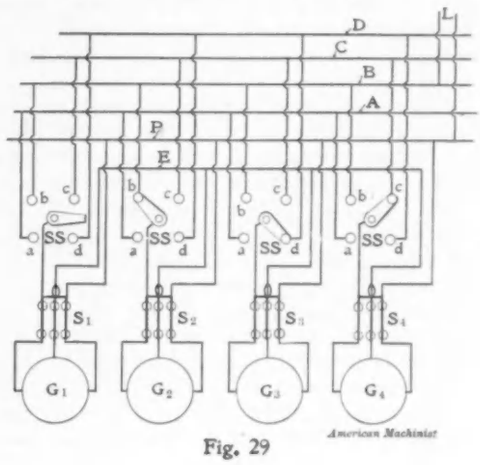


Fig. 29

THE USE OF MULTIPLE POINT SWITCHES.

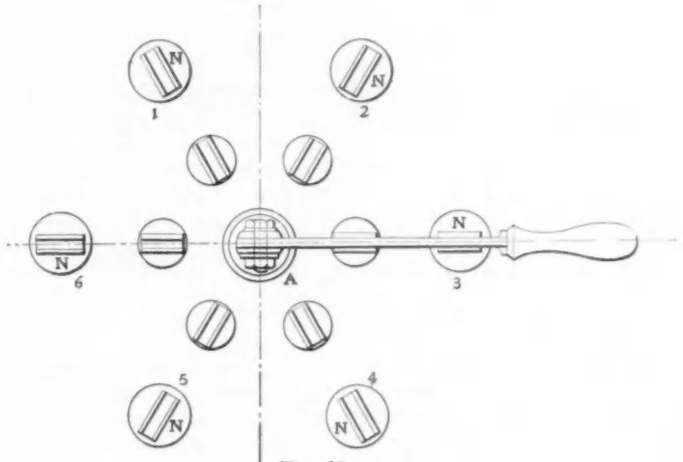


Fig. 30

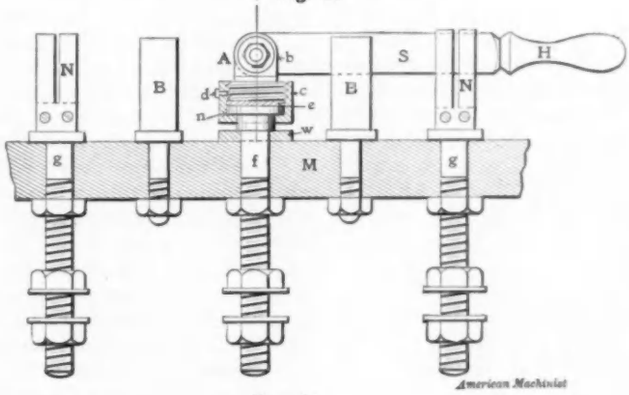


Fig. 31

SWIVELING KNIFE BLADE MULTIPLE POINT SWITCH.

by means of two-pole switches, the grounded circuit would be the only one that could not be used.

As another illustration of the applicability of multiple-point switches, take the case presented in Fig. 29. Here we have four generators which we desire to arrange so that they may feed into any one of four bus bars *A, B, C, D*. We then provide an equalizing bus *E*, to which the equalizing connections of the four generators are run, these being the lines coming from the center terminals of the three-pole main switches S_1, S_2, S_3, S_4. We also provide a bus *P* to which all the positive generator leads are connected. The negative wires of the generators we connect to the blades of the *S S* switches, each one to its respective switch. The four contacts of the *S S* switches we connect with the four busses *A, B, C, D*. It will now be seen that we can turn all the generators upon any one bus—that is, of the *A, B, C, D* set—or we can place one on each bus, and can change the generators around in any way we please. If generator G_2 is connected with bus *B* as shown, then the circuit *L* which is fed from this bus, will be supplied by this particular generator, the current passing out from the *P* bus and returning to the *B* bus. All the distributing circuits will have to be connected one side with the *P* bus, the other side connecting with whichever one of the *A, B, C, D* busses we wish the line to be fed from.

In this case, as in Fig. 28, the objection is that the several circuits are not wholly isolated, but are all connected together through the *P* bus. It can be readily seen, however, that to be able to shift the connections around as much as in this system by the use of two and three-pole switches, would require a much more elaborate switchboard than we have here shown, but at the same time the circuits would then be entirely independent of each other. It would require three double-throw switches to take the place of a single *S S* switch, and the number of busses would be increased to eight, exclusive of the equalizing bus. In cases, therefore, where entirely independent action is not essential, the multiple-point switch will simplify the switchboard and reduce the cost of construction.

Figs. 30 and 31 show one type of multiple-point switch in plan and side elevation, the latter being partially in section. This type is what might be called the swiveling knife-blade type. The switch is of the knife-blade type, with the pivotal point arranged to swing around the circle. The stands *B B* are simple guides to insure alignment between the blade and the contacts, so as to avoid sparking when closing the switch. As seen, the upper end of *f* is enlarged, having a wide flange at the top and a shoulder below this. The washer *w* resting against this shoulder prevents the cap *c* from being clamped tightly, and also allows *A* to revolve without carrying *f* with it. Between *c* and the under side of *A* there is a spring of sheet metal marked *e*, the object of which is to produce a pressure between the stationary and moving parts so as to insure good conductivity.

Figs. 32 and 33 show a side-throw multiple-point switch in plan and sectional elevation. This design is simpler than that shown in Figs. 30, 31, and less troublesome to mount upon the board, as there are no guides *B B*, and consequently a fewer number of holes to drill in the marble slabs. The handle *m* is a casting to which the blade *S* is secured by rivets *t, t*. To secure a good contact between *S* and *f* a spring washer *n* is provided. The terminals *N*, as will be noticed, are of the type mentioned in the last article and illustrated in Fig. 26. The studs *g* hold the contacts in place and also conduct the current, the same as the *g* studs in Fig. 31. As *g* is located about opposite the center of the contact surface there is little tendency for it to shift around out of position, but this small tendency is prevented by dowel pins, which are shown in dotted lines in Fig. 33 and at *P* in Fig. 34. This latter figure shows a type of contact that is frequently used with side-throw switches. It is more substantial than that drawn in Figs. 32 and 33, owing to the fact that the upper part *N* is a heavy casting. The necessary pressure upon the blade *S* is secured by the tension of the spring *a*, and the stop, beyond the center, prevents *N* from dropping too near to *D* when the blade passes out of engagement. This type of switch is more desirable than that of Figs. 30 and 31 when the number of points is small, from four to six, but for a greater number of points it is not suited unless the voltage of the current is very low. For very small currents it can be made with any number of points, but not for strong currents.

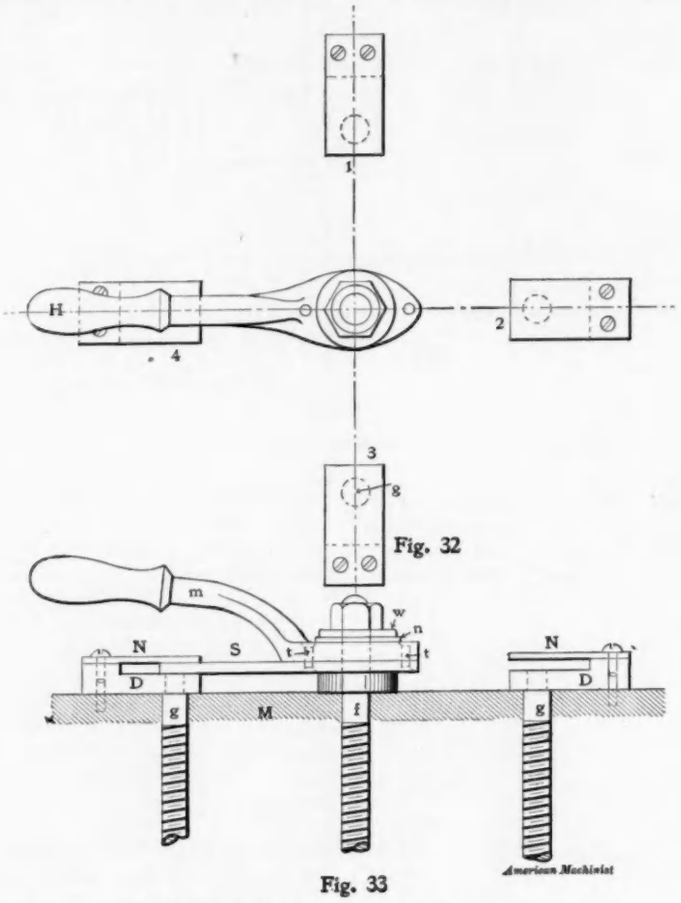


Fig. 32

Fig. 33

A SIDE-THROW MULTIPLE POINT SWITCH.

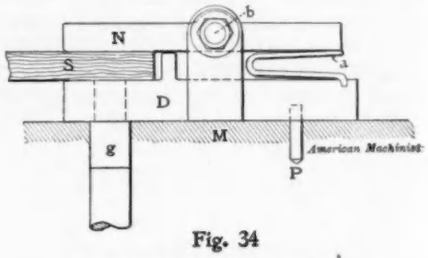


Fig. 34

A TYPE OF SWITCH CONTACT.

There is a scheme advocated by some experts across the water to supply each passenger train with partially collapsable cars. A sort of spring-bumping post on wheels to be placed ahead of the baggage car and behind the last coach, whose object is to avoid telescoping and reduce the force of the shock in case of accident.

The Importance of Hastening and Controlling the Rate of Cooling of Aluminum Castings.

The attention of our readers has recently been called by one or two articles in our columns to the different effects of different rates of cooling upon the ultimate molecular structure of cast iron as exhibited in its fracture. It has been shown quite clearly that iron of a given quality shows a finer grain and is graded differently if cooled quickly than if it is allowed to cool slowly. It is something of a coincidence that just at this time our attention is called to similar phenomena connected with the casting of aluminum and its alloys. Several United States patents have recently been granted to Mr. William A. McAdams, Borough of Brooklyn, City of New York, for a method of casting aluminum alloys, the essential feature of which is the rapid removal of the heat from the molten mass after pouring. From the specifications of a patent relating to the casting of aluminum alloys composed of aluminum, zinc and copper, with or without a small percentage of nickel, and in which the metal aluminum predominates, the following interesting information is taken:

"Aluminum when melted cools slowly, so slowly that other metals which are present in molten state in the molten aluminum are permitted to segregate and form large crystals before the slowly-cooling aluminum checks to any considerable degree their segregation and crystallization, thereby materially reducing the strength of the casting. Furthermore, the zinc and copper, because of their greater specific gravity, have a tendency to fall toward the bottom of the molten mass, and thus render the casting non-homogeneous.

"The object of my present invention is to prevent such segregation, crystallization and stratification of the mixture during the process of the cooling, and thereby to add material strength to the casting.

"In an alloy composed of 72 per cent. aluminum, 24 per cent. zinc and 4 per cent. copper, or similar alloys in which the aluminum forms a greater part of the alloy, the hereinbefore described segregation, crystallization and stratification of the commingled metals will be liable to take place unless the molten mass is cooled so rapidly after pouring as to check the segregation and stratification before it can have proceeded to any great extent. By means of numerous experiments I have found that the cooling should take place rapidly within certain well-defined practical limits, and that the heat should be taken from the molten mass at as nearly a uniform rate as possible. This may be accomplished where the casting is thin or small by using a metal mold of sufficient thickness to quickly remove the heat from the casting, and when the casting is to be thick or large the mold may be surrounded by a cooling medium to assist it in removing the heat with the required speed and uniformity.

"To carry out my process successfully, the heat should be removed from the casting as rapidly as at the rate of one-fifth of a calory per second, and, on the other hand, it should not be removed more rapidly than at the rate of two calories per second, as when removed more rapidly than this rate the sudden chill is found to produce the same weak structure that is produced when the heat is removed at a rate less than one-fifth of a calory per second. The best results are obtained by removing the heat at the rate of from one to one and one-tenth calories per second—a rate much more rapid than is common in the ordinary use of metallic molds. I found that this treatment of aluminum alloys in which the aluminum forms the greater part of the alloy will increase the strength of the casting from 80 to 100 per cent.

"I have found by careful experiment that a bar composed of aluminum, zinc and copper, combined in substantially the proportions hereinabove mentioned (viz., 72 per cent. aluminum, 24 per cent. zinc and 4 per cent. copper), .968 of a square inch area in cross section, cast by the process hereinabove set forth, supported upon inverted-V edges 12 inches apart and with the weight applied by a V edge midway of its point of support, showed a transverse stress of 3,200 pounds, with a deflection of .21 of an inch under a load of 3,200 pounds, the same bar showing a tensile strength of 39,000 pounds. A 2-inch length of the bar standing on end supported a load of 70,000 pounds without visible deformation and actually sustained over 98,000 pounds before breaking with a shearing crack. I have further found by careful experiment that a similar bar of metal, composed of the same material and in the same proportions, cast in the ordinary manner and allowed to cool at a rate not greater than one-fifth of a calory per second, showed a transverse stress, under the same conditions as before, of only 2,050 pounds, a deflection of .13 of an inch under a load of 1,900 pounds, and a tensile strength of 22,000 pounds."

Something About Valves.

BY W. H. WAKEMAN.

As a rule, the throttle valve of an engine is considered a part of the machine, therefore it is furnished by the engine builder, and the engineer must use whatever comes with the engine unless he can show good reasons for rejecting it. In one case where I assisted in setting up an engine that I was to run, no throttle valve came with it, so that I was free to choose any one that promised to do good work. Having always used throttle valves in which both disk and seat were made of brass, I concluded to try one with a removable disk made of a different metal, and I accordingly ordered one of this type. This decision was due to the fact that the brass valves sometimes leak, so that the cylinder is kept warm and the boiler pressure is reduced during the night.

The improved valve came, was put up, and I regret to say that it was not satisfactory, and it is the first and only case of the kind that has come to my notice, but the facts are given as I found them. This valve was shut tight at night, and showed no signs of leakage, either by hiss of steam or by defect in seat or disk; but when first shut it was hot, after which water would collect in the pipe above it, and as this was somewhat cooler than the steam, it caused the disk to contract and allowed the water to pass, after which it became tight again. This operation would be continued indefinitely, for the principle is the same as that on which the expansion trap or an air valve on a radiator operates. Here, then, we have a tight valve that will not prevent water from passing, which is a paradox, but the facts in the case are as stated. Nevertheless, I always order these valves for other places, and find that they are eminently satisfactory.

The advantage of being able to quickly remove a worn-out disk and to insert a new one is very great, for one seat will usually outlast many disks, partly because when a foreign substance is caught between the two surfaces, it is embedded into the softer metal or substance, while little or no injury is done to the seat. Sometimes these old disks become very hard, so that it is difficult to remove them, in which case they should be heated in the flame of a gas jet, which will at once soften them so that they may be easily taken out. Engineers of steam plants should always keep a complete stock of these disks on hand, in order to have one or more at any time they are wanted; for when steam is down, on Sunday or some holiday, there are chances to take out valve bonnets and examine the internal parts that are not afforded at other times. and it also may be difficult or impossible to purchase them then. Furthermore, when they are bought only as wanted to use from time to time, it shows a lack of good judgment on the part of somebody who should mend his ways. When the bonnets of valves are screwed on (as they are for all small sizes), it is probably done by machinery, for it is difficult to start them when new, and after they have been in use under steam for several months it is practically impossible to start them without rounding off the corners badly. In consideration of this fact, it is well to loosen these bonnets while they are new, and then screw them down enough to secure a tight joint and no more. It would surprise some engineers if they should try experiments to determine the least pressure that will accomplish this, for they have a great desire to be on what they

call "the safe side," which means to strain the valves to the best of their ability.

The bonnet of a large valve is bolted on, and the threaded stem passes through a yoke, so that the condition of the thread may be known at all times. This is a valuable feature, especially when high pressures are used; for careful inspection of an ordinary valve, say 2 inches or less in diameter, will show that the threads hold but little. When such a valve is open the threads hold well in the bonnet, but there is little stress on them then; yet when it is closed there may not be more than one thread to hold the pressure, and this is when the greatest stress comes upon the stem.

Brass valves are usually fitted with beveled seats, as it is claimed that the wedge-like action keeps the valve tight; but I have used a throttle valve with a flat seat for more than five years, and it is still perfectly tight, either when cold or hot, and this shows that no one rule can be laid down to cover all cases. A throttle valve, however, is used under more favorable conditions than many others are, for the lubricator is, or ought to be, located so as to discharge the cylinder oil in front of the valve, so that it is well lubricated at all times. We commonly find gate valves in lines of water pipes, and usually they are superior to globe valves, or to stop cocks; but frequently there is an "L" near by, and an angle valve might have been used at this point, thus requiring one fitting and two joints less than with the ordinary arrangement.

Why don't some of our valve manufacturers put a valve on the market that is suitable for such work? The removable disk in valves for use on steam lines is all right, but it requires the heat found there to soften the disk and make it fit the seat. This process is not practical for cold water, therefore some other material should be used. I have taken out a hard rubber disk and put in one made of belt leather, which answers the purpose well; but it takes some time to do it; the leather is not thick enough to fill the space provided for the disk, and the whole is not as satisfactory as a valve designed for the purpose would be. Near the desk where I am writing, there is a line of galvanized water pipe, in which there is a tee, in order to run a branch line into another room. A nipple about 5 inches long is screwed into this tee, followed by a gate valve. If the pipe fitter had used a cross valve in place of that tee, no nipple would have been necessary and a much neater job the result. It takes a comparatively long time to open and shut a gate valve, and when it is necessary to partially open it, in order to use only a part of the capacity of the pipe, it is difficult to gage it, as all who have tried it know; but with an angle or a cross valve it is much easier to get a full opening when it is wanted, and a partial one is also readily secured.

There is a much better grade of gate valves in the market now than was furnished us several years ago; as I put in a pair of them for boiler blow-off valves, a long time ago, and they were not satisfactory, for in a few weeks they leaked badly. For several years after this experience I would not use a valve of this type for such service; but more than five years ago I commenced to use four nickel-seated gate valves for the above mentioned purpose, and they are very satisfactory, because no water passes them when shut.

Letters from Practical Men

Pioneer Engineering.

Editor American Machinist:

The mechanic or foreman in the shop who has never been out to put up plants of machinery generally thinks the outside work a snap or cinch; some might put it, "a puden." But those of us who have had six to ten years at it say "All is not gold that glitters." The foreman came along one day and he said: "I want you to go down South, put up that mill and stay with them for a time and get them running all straight." Well, I packed up my overalls and jumper, with hammer and wrench, etc., inside, while the boss hunted up the route and counted out the dough for expenses. "Now," he says, "all you have to do is just to set the engine on the foundation, bolt her down, and while the foundation is drying set your boiler, put up your stack, get your shafting and machinery up, and you are ready to start." Sure. Just like rolling off a log. About two days or so; that's all.

Well, I started, and if you want to see some crooked railroading, go South, young man. It was a wonder to me that the old locomotive did not have to stop and inquire the way. But we got there safe and sound. The hardest thing about it was to tell when we did get there. The train stopped just at the edge of the woods, where a cart path led off to the south, and the conductor said, "This is the jumping off place, young man. I have done all I can for you. Ta ta!" Well, I looked about, and as that train disappeared I began to wonder if I should come across poor old Robinson Crusoe, as I was sure no one else would live there. But I was mistaken; for after a while I noticed a small frame building in the distance, and made a bee line for it. I said "This must be the city hall or the capitol building, and I may get some information that will help me out." When I entered I found, not the Mayor and Common Council, not even an Alderman, but a real, live department store. When I told the proprietor what I wanted, he said: "Why, yes; there's your boiler, over there on that car in the edge of the wood. The mill where you are to put it in is about three miles from here, through that last path you see over there." I said, "You can't telephone to them and let them know I am here, can you?" The fellow didn't drop dead, but he said, "Young man, you're dead slow. Just go over to that farm house and get the old man to hitch up his team and he'll take you over in half the time." Well, I saw the old man and his team (a yoke of oxen), and made arrangements to haul the machinery and do the other work needed.

The first puzzler was how would we get that boiler through the woods? We soon had it down fine. After rolling it from the car and unloading the engine, with the balance of the work, we took the timbers and lashed them to two sets of cart wheels, as shown in Fig. 1, and rolled the boiler on. We then lashed it to the timbers as firmly as possible, and we had very little trouble in hauling it to the plant. But this was one of the least of our troubles. When I left home I expected to find the foundation for the engine in and ready to start putting the work together. But their lack of knowledge in this direction had tended to make them hold off. The help that presented itself was from the colored population, and I was told that this would be the hardest part of my job—that is, to get the darkies to do a day's work. But this I found to be the least of my trouble, for by handling them carefully and with judgment, I succeeded in getting along in good shape.

In digging out for the foundation, we came to a soft quicksand that would flow in as fast as we could take it out. This was a part of our "snap." The first thing we did was to rig up a staging. Then we cut a lot of cedar trees, about 8 inches diameter, sharpened the small ends, and set one up in the sand, and with a section of a tree about 6 feet long and 10 inches diameter, we made a pile-driver, by boring three holes, at thirds, and putting in three pins about 10 inches long and 1½ inches diameter for handles, as shown in Fig. 4. With this, operated by three men, we did a very fair job, and made a base for the foundations that answered every purpose.

Our next trouble was to get the boiler set up for the brickwork. This we did by skidding it to its place, prying it up one end at a time and blocking after it was set. We bricked up far enough to hold it firmly in place, and then proceeded to put up the iron stack. The reason for leaving the brickwork unfinished was to have room for the shear pole, as shown in Fig. 3. We had to place it as near the boiler as possible, in order to place the stack in position after we had raised it. The rigging up of the shear pole was no small part of our job. We had to go out into the woods, select a good, tall tree, cut it down, trim it and haul it to the boiler. The next thing was to raise it; and to do this we dug a pit about 6 feet deep at one end and ran it out at the surface, as shown

in Fig. 2. Into this pit we lowered the large end of our pole, fastened a block and fall at the top for raising the stack, and we were ready to up end it. This was accomplished by running a line from the top end, back horizontally about 200 feet, to a block and fall. Before raising the pole, we found we should have to climb up to loosen the lashing, after hoisting the stack. To make it easy for climbing, the spikes marked *a* were made use of. It pays to think, on jobs of this kind. After the pole was up in place, we lashed the stack to the hook of the lower block,

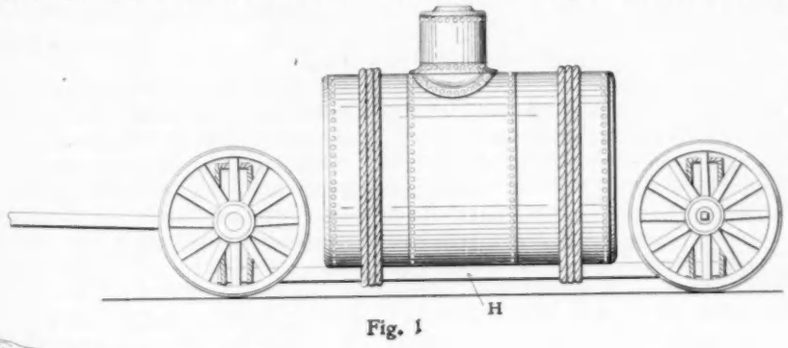


Fig. 1

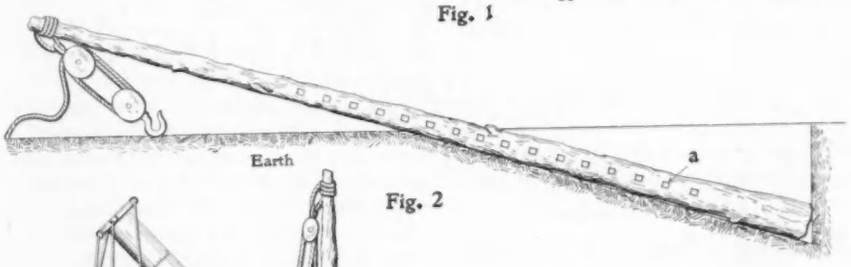


Fig. 2

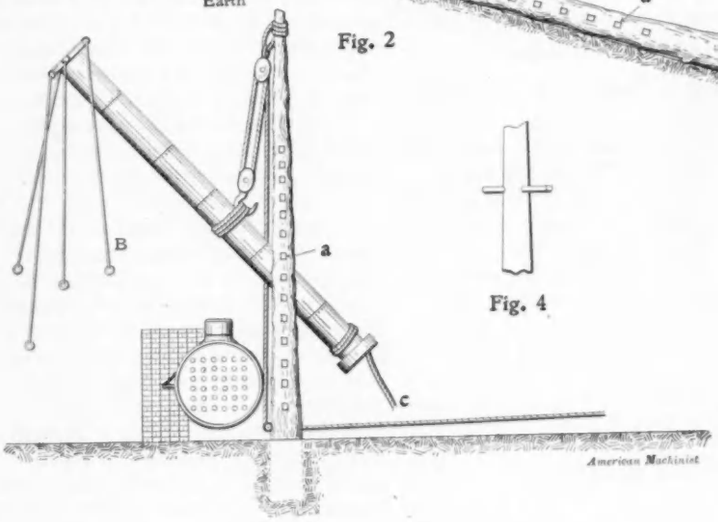


Fig. 3

Fig. 4

BACKWOODS ENGINEERING.

fastened the guy rods to the top, and up went the stack by means of the block and fall.

The whole job took about four weeks; and, while it was very hot weather and very puzzling all the way through, there was a good deal of satisfaction at the finish. And the most pleasing part was to see the colored gentlemen getting away with their cigars when all was done. Talk about dudes! No comparison. It was a treat to me as well as to them. After our part of the job was completed, they put up the building over it, and I suppose the mill is still grinding away.

H. S. BROWN.

"It Pays."

Editor American Machinist:

In one corner of the women's dining room, just over the entrance to the little "rest room," in the factory of the National Cash Register Company, there hangs a placard on which is printed in large letters two little words, "It Pays." This, a visitor is informed, after the many privileges enjoyed by the employees there have been enumerated, is the answer to a question that naturally suggests itself, viz.: Why do you do all these things, which are so radically different from what is the general custom in other factories? Is it because the proprietors have such a kind feeling toward working people that they are running this great establishment to help to elevate them, and are content in using up all surplus earnings for that purpose? The answer is complete. Here we have the word of a prosperous and reputable firm that "it pays. What pays? It pays to have contented employees and to use every means for keeping them so. A contented workman will do more and better work than a discontented one. A contented man feels at home and is progressive. A factory full of them is progressive.

It pays to encourage mechanics to think along new lines, a privilege which a great many are denied. Without fresh thought the mind becomes stagnant. Give every man a chance to live up to his highest possibilities and he will be far more valuable both to his employer and himself. This company not only allows its employees to make suggestions, but pays them premiums for doing so, and encourages them in every way toward it. They even have one of each of the different kinds of cash registers made in a skeleton framework and placed on a table in a part of the shop accessible to all, for the use of employees, so that if they desire they may study the construction and working principles of the machines they make parts for. What a contrast to some of our large sewing machine factories, for instance. There each workman, of course, does some operation on some part or makes the part complete. He knows how it should be done, knows that it must conform to certain gages, and knows how many he is expected to make in a day, but where it goes or what it is for is supposed to be none of his business.

"It pays," for we observe, as this factory grows, additional benefits are received by the employees, and in consequence the place grows still larger and better. Does anyone suppose that the 1,950 employees there are going to allow any other firm to make a better cash register than theirs? In union there is strength.

Is there any factory manager who can afford, in this day of close competition, to ignore anything that pays? Why don't they "catch on?" There is a foolish pride in the majority of men, managers as well as anyone else, that works decidedly against their own interest. It would seem humiliating to them if some common workman under them could claim the credit for some new idea adopted, and it not infrequently happens that an intelligent workman is snubbed for daring to offer a suggestion. I hope to see the day when there will be a hundred factories in this country running on lines essentially similar to those of the National Cash Register Company. Then hundreds of others will be compelled to, or go out of business. "It pays." H. B. MCCABE.

Cleveland, Ohio.

Arc Lights in the Drafting Room.

Editor American Machinist:

The artificial lighting of the drafting rooms of commercial and educational institutions has always been a perplexing problem. In the case of educational institutions the problem is of serious importance, especially in the higher departments of machine design, where the student is compelled to devote four or five hours a day to the analysis of complex mechanisms with minute exactness. Particularly during the winter, when artificial lighting is necessary the greater part of the day, poor lighting is manifestly deleterious and very

apt to cause permanent injury to the eyes. Poor lighting does not necessarily imply a deficiency of light; on the contrary, the opposite is usually the case. Take, for example, the common practice of suspending a 16 candle-power incandescent lamp directly over the work. Here the light is too direct, reflecting a dazzling glare from the paper, and casting deep, annoying shadows. It also lacks penetration, as is particularly noticeable when using tracing cloth; 32 candle-power lamps with frosted bulbs mitigate the evil to some extent, but fail to meet the requirements of a perfect light. The heat of the lamp is also disagreeable, causing dull pains in the head after continuous use, and often incapacitating the student for further work.

In the lighting of the main drafting room of the Armour Institute of Technology, Chicago, Ill., the problem was unusually perplexing on account of the capacious dimensions of that room, 55 x 55 by 25 feet, and on account of the great number of drafting tables therein contained, one hundred and four standard tables, each 36 x 42 inches; besides, the surrounding woodwork was to be left in its natural dull color. The first system consisted of suspending a network of molding, etc., several feet above the tops of the desks so that each table might have its own 16 candle-power incandescent lamp, pendent, with adjustable flexible wire cord, and fitted with separate rosettes or fuse plugs. Branch blocks were also used with each row of lights to localize the evil effects of possible short-circuiting. The advantages of this system are obviously the facility with which the necessary lights are brought into use and the consequent resulting economy in power. This system was used for some years and proved unsatisfactory for reasons inherent in incandescent practice as stated above, and because the overhead network, in addition to its unsightliness, became a harbor for dust which persistently deposited itself upon the drawings. The use of 32 candle-power frosted bulb lamps would have been a material improvement, but was impracticable, as 104 amperes would have proven an unwieldy and dangerous current for the light, exposed woodwork.

The present system of arc lights was installed this fall, and is a marked improvement over the old one. Nine 1,200 candle-power enclosed arc lamps with opal globes and reflectors, one lamp for every 120 square feet of desk surface, are suspended from overhead girders and distributed symmetrically throughout the room. These lamps are connected in parallel and burn with an arc of 80 volts and current of 5 amperes on a circuit of 120 volts, direct current. They burn 130 hours before renewal of carbons is necessary. The drafting tables are arranged in groups so that the lamps may hang over the aisles, and so that each light may dissipate the shadows of the others. The hight of each lamp is adjustable, but experience has shown that a common distance of 7 feet above the tops of the tables gives the best results.

Single lamps occasionally become unsteady when regulating, but the evil therefrom is almost entirely overcome by the lights of the others. The light, *in toto,* is soft and diffused, yet powerful; it is satisfactorily steady, has great penetration, and is remarkably free from deep shadows. The heat is also imperceptible. The students are able to work much longer in this light without fatigue, and in no instance have they experienced any deleterious effects. The only objection to this system lies in the extravagance of power due to the inability to regulate the amount of light in proportion to the number of students. As it is, a few scattering students use as much light as a full quota.

Experiments conducted with the use of both arc and incandescent lamps gave varying results, but proved beyond a doubt that one or more arc lamps judiciously placed will more than offset the increased cost of power with the increased value of the lights, toning down the high lights and softening the shadows to a great extent.

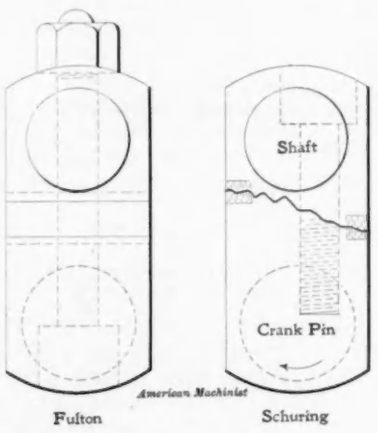
The success of the present system is entirely due to the use of a *number* of arc lamps, as each is able to modify to some extent the shadows of the others, and thus conjointly produce a soft and diffused, yet powerful, light.

G. F. GEBHARDT.

Repairing a Broken Crank Shaft.

Editor American Machinist:

That broken crank shaft which Mr. Brown repaired in your issue of September 28, is just the kind of a job that is in the habit of coming to the regular jobbing and repairing machine shop, so I can very well understand how and why it should have interested many of your readers, and how also many of them may have been provoked to suggest how they would have done it. I cannot very well refrain from asking why in the world the job was done in the way shown. I suppose there was no room outside the crank-pin end of the crank web for a bolt head, but there was certainly room at the inner end for a nut, so that if a plain hole had been drilled clear through the web, with a counter-bore for the bolt head, a plain round bolt could have been fitted to the hole with a nut on the inner end (see sketch), and the bolt could have been tightened much better, would have held stronger, and the job would have been done quicker and cheaper than in the way shown by Mr. Brown. Full advantage could then have been taken of the shrinkage pull of the bolt after heating it; while Mr. Brown's bolt, I am afraid, must have got nearly or entirely cold before it was fully tightened.



BROKEN CRANK SHAFT SUGGESTIONS.

MORRIS FULTON.

Editor American Machinist:

Referring to the article, "Repairing a Broken Crank Shaft," on page 920, I would have put that large steel bolt over to the pull side, instead of in the middle (see sketch). Two or four threaded plugs would have kept the joint in place.

J. SCHURING.

Chicago.

Forty Year Comparisons.

Editor American Machinist:

The recent comparisons which we have all been making between the "Oceanic" and the "Great Eastern," showing the enormous advances which have been made, in detail and in general, in the design, the material, the means and mode of construction, and the magnitude and the economy of power development suggest some other comparisons which also it is quite possible to make at the present time. The launching and the first voyage of a ship give sharply defined occasions for description and comment which do not occur with some of our other important constructions, and the latter therefore thus escape the formal notice and mention which they deserve. There is no day and hour set for the launching of one of our modern office buildings, and there is also no day and hour when such a building is at once filled with tenants in successful occupation, and so they do not always get such a handsome send-off as the ships get. It is quite possible that our building upon the land could show as great advances as our naval architecture if it had a chance.

It is something over forty years since the completion of the "Great Eastern," and it is also something over forty years since there was erected in New York a building which may afford a good opportunity for comparison with those of recent erection. The building that I have in mind is Tompkins Market, which stands just across the street to the east from Cooper Institute. It is to be assumed that this building represented the best or nearly the best work of its time. To-day it is a cumberer of the ground.

The building is of cast iron, and I am privileged to speak of it, because I worked in the shop upon some of the material of

it, and that job was a godsend to me, if I ever experienced one. The contractors for the material of the building were Starbuck Brothers, Troy, N. Y., and the work was done immediately after the terrible panic of 1857, when the State banks suspended specie payments. The prostration and utter paralysis of business which followed that event are not to be compared with any experiences of a similar kind which have occurred since. The highest wages paid to the machinists in the shop in 1858 was $1.25 per day. I, who had not become perhaps quite a full-fledged machinist then, got $1.12½. The foreman of the machinists, over about 100 men, got $2.50. There is not in this the slightest suggestion of reproach against the firm, for they were the most liberal men I have ever known. At those figures they were turning away flocks of men every day.

The building, as I said, was of cast iron, and it was built also upon the old idea that the walls sustain the building. The entire exterior of the building, therefore, was cast, and the castings were fitted together, mostly by hand chipping, were piled one upon the other and secured by bolts where necessary. The only machine work, as I remember it, was the planing, top and bottom, of two or three strings of heavy castings which ran around the building horizontally below and above the windows, and the drilling of small pieces for the capitals of the pillars and other decorative work. Of this latter I had a large share; but, like most of the other machine work that I have done, there is little assurance that it will be enduring.

Much of the iron and steel that I have handled has already gone to the scrap pile and beyond it, and the rest of it is going. My earliest steady work in the machine shop was in northern New York, in a shop where they built the machinery for the sawmills that were then laying bare, or laying waste, the Adirondacks and all that once densely wooded region. I was indirectly, therefore, a wood-worker in those days, a maker of sawdust, and in that capacity I was assisting in obliterating a beautiful sheet of water over which I used to sail in summer and skate in winter, where I caught large strings of fish, and where a loon used to dodge the rifle shots from the banks. Grass is growing there now, and the filling-in was done by the sawdust brought down by the Saranac River. Some fellow before long will be selling building lots there, and I will have helped to set him up in business. Thus does one effect follow another.

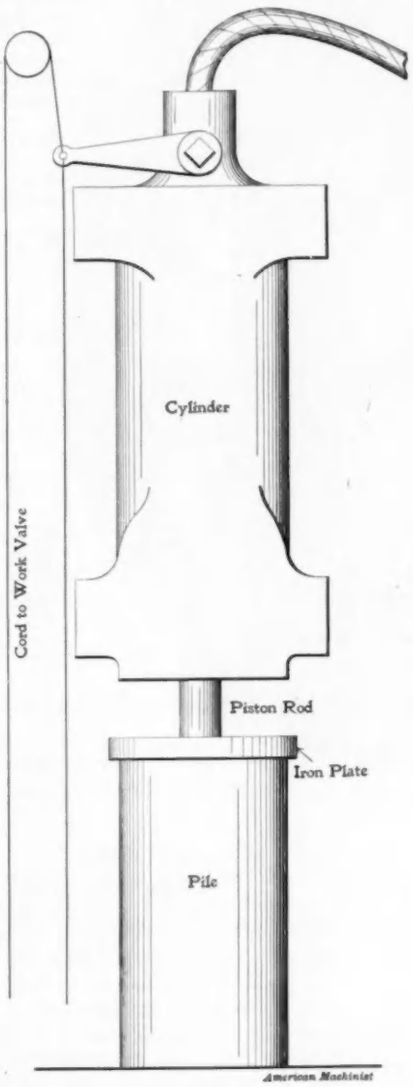
We would certainly have built a better building than we did forty years ago, but for our far-reaching ignorance. It is not merely or mostly with the designer. If we had known then, as we did not, how to design the modern building, we would still have been as far as ever from the building of it. If the plans and specifications in all completeness could have been put into our hands, we must have rejected them as impossible of execution. We had not the materials or the modern devices. All the steel we knew was cast steel, so to talk of a steel building would have been absurd. The modern building, so superior to the old, and built at one-fifth of the cost per cubic foot, is the product of far-reaching and all-embracing knowledge, and though it is through and through indebted to the machinist more than to any other craftsman, it is still the machinist in co-operation with all the rest.

TECUMSEH SWIFT.

A Novel, Ancient Pile Driver.

Editor American Machinist:

A local spot of bad ground, just where an important foundation was wanted in a shop building already roofed in, called for the driving of a few piles. As the available headroom seemed to me to be insufficient for the required drop of the driving weight, I for once expected to find our Berlin Herr Baumeister stumped, but he only smiled, and next day showed up with a still broader grin and the pile-driver of the sketch. He told us that there was nothing new about the thing, the design having been in use so many years that he did not remember its introduction; certainly this particular one bore every earmark of not only age, but faithful service.



A SIMPLE GERMAN PILE DRIVER.

The pile-driver is a vertical steam cylinder of great weight; the piston rod is cut off square at its lower end and is flush with the cylinder face when the piston is at the top. The whole is placed on a pile with the lower cylinder face resting on the pile head. A plug-cock controlled by a cord admits steam above the piston to raise the cylinder in suitable, very light guides, while the end of the piston rod remains on the pile head and serves as the abutment. The steam having been admitted at the top, when the cylinder has gone as high as required for the blow wanted, the attendant closes the cock to live steam and opens it to exhaust, and so lets the cylinder drop down onto the pile.

The rapidity with which one of these pile-drivers acts must be seen to be appreciated. It certainly is far ahead of the usual high-drop style in this regard. Its action is also likely to be less destructive to the pile top, as the comparatively short stroke compels the use of a heavy ram, whose work is expended in driving the pile down and not in converting its top into a very poor broom. Should this type of pile-driver not be novel on the American side, those who are familiar with it will kindly remember that there are probably many others who, like the writer, have never seen one.

HENRY HESS.

Berlin.

The Secor Engine—A Correction.

Editor American Machinist:

A letter from Brooklyn has been forwarded to me, signed F. D. Howe, calling attention to an error in the figures in my letter regarding the Secor engine. Mr. Howe states that the drawing in the "American Machinist" is of the Secor 6x 9 engine, that the connecting rod is six times the crank length, and that these proportions are standard for all sizes. On referring again to the drawing in question, I find that Mr. Howe is correct, and that an inadvertent confusion of scales led me to do Mr. Secor an injustice. I take pleasure in making the correction public, and will add that for a stationary engine the proportions could not have been better.

Reading, Pa. HERBERT L. TOWLE.

The Secor Motor—Qualifying Clauses.

Mr. Herbert L. Towle, of New Haven, Conn., contributes an article to your issue of October 26 relating to the Secor kerosene oil engine, in which he criticises the motor and casts doubt on some of my statements.

In regard to the Secor motor, I have only to say that its location is given, and the machine is wide open to public inspec-

tion, and no rainbow coloring in print would last a minute under inspection of the motor itself at work. I said in my description of the Secor motor, that it did deliver cold kerosene oil into a cool part of the charge intake without vaporizing by heat, and that the motor ran at a high speed and as smoothly as a good steam engine; governed well, and did not make an offensive exhaust. It is not very far from New Haven to Forty-third street and New York Bay, Bay Ridge, Brooklyn (not Bay Ridge "Bridge," as the "American Machinist" prints it), and as Mr. Towle seems interested in internal combustion motors, he might obtain some new ideas by seeing the Secor motor at work.

Mr. Towle says that the line drawing ("American Machinist," October 5, page 29) shows a square engine, stroke equal to cylinder bore. Both crank radius and cylinder diameter are clearly shown in the line drawing of the Secor motor, and the stroke is equal to one and a half piston diameters. And why does Mr. Towle speak of the "awkward flywheel?" All flywheels are awkward things, fast enough, but the Secor flywheel is no more awkward than any other Otto cycle motor flywheel, unless crooked arms are referred to; and it is only fair to say that the crooked arms shown are not the regular Secor practice, straight arms being the rule. The Secor motor is not at all light. The 8x12-inch cylinder weighs, in the rough, 540 pounds; the bed is light, and the steel framing is light; but the shaft is extremely heavy, being one-half the piston diameter, and so are the flywheels and the cylinder.

Possibly it was a surprise to Mr. Towle to know that cold kerosene oil could be fed into an engine cylinder and made to burn well.

As to Mr. Towle's two articles on "Gasoline Engines in Boats," he shows conclusively—by figures—that the internal combustion motor cannot be balanced. This statement should also have been qualified. I assert that the internal combustion motor can be placed in such form that it will be in perfect balance, both standing and running.

HUGH DOLNAR.

A "Reminder" on Isometric Projection

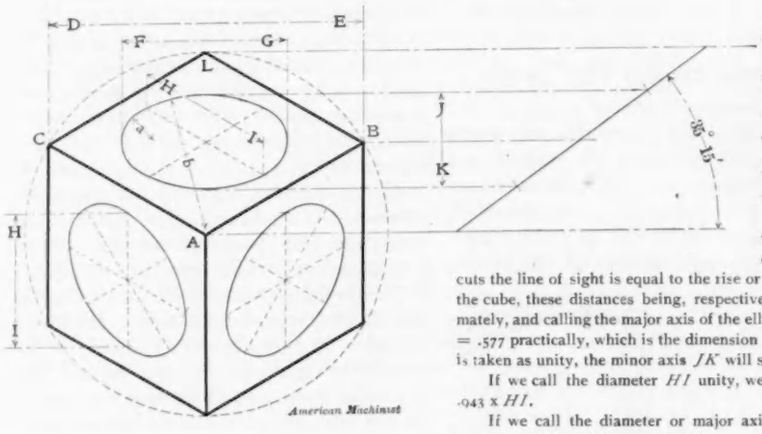
Editor American Machinist:

There have been several short articles in your paper lately on isometric projection drawing that have been very interesting. Many details can be readily expressed in this way to very good advantage, I believe; particularly in patent office drawings, where I often see it, and in machine shop drawings, where I rarely see it.

For quick and ready reference I made a tracing some years ago, of which I enclose you a print, intending to briefly cover the principal points in this method of projection and such figures as are often wanted in making drawings in this style. Things like this we learn in the regular course, and, being easily learned, they are easily forgotten if we have no practice in the use of them for a few years, and when we need them, in haste perhaps, have to take time to think them out, or read up on them. This sheet was intended to save a large part of this time by acting as a "reminder."

F. W. SALMON.

Burlington, Iowa.



In isometric projection all horizontal lines are drawn to scale at an angle of 30°, as AB or AC.

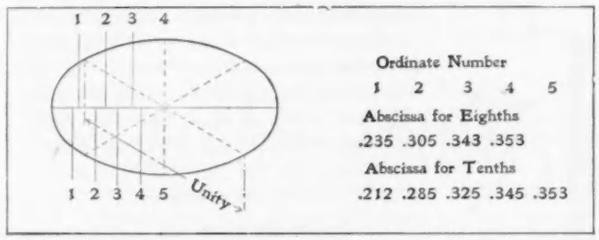
Assuming then that each of the lines AB AC scale 1 inch by our scale, the dimension DE will scale cos. 30° x 2 = .8660254 x 2 = 1.7320508, while this dimension on the actual material cube represented will measure sec. 45° x 1 = 1.4142136. Therefore the major axis of the ellipse we draw to represent the circle must be in the ratio of 1.7320508 ÷ 1.4142136, about 1.225 to the diameter by scale, the scale diameters being measured on the 30° lines HI, for the horizontal circle and on the vertical, and 30° lines for the vertical planes, as shown.

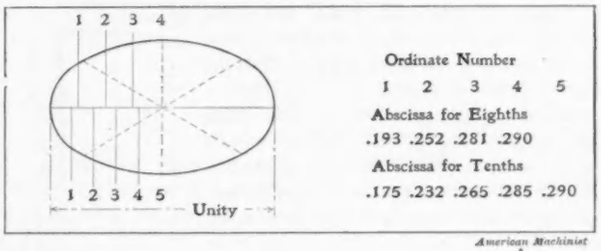
Now, as the upper surface of this cube is a square, the diagonal distance across corner in any direction must be the same as in any other direction. Therefore, the angle at which the upper plane of the cube cuts the line of sight is equal to the rise or sin. distance AL in the diagonal distance DE, as shown to the right of the cube, these distances being, respectively, 1 and 1.7320508, from which we obtain the angle 35° 15′, approximately, and calling the major axis of the ellipse unity, the minor axis will therefore be 1 ÷ 1.7320508, or sin. 35° 15′ = .577 practically, which is the dimension JK when the dimension FG equals unity; or, if the scale diameter HI is taken as unity, the minor axis JK will scale .707, and the major axis will scale 1.225.

If we call the diameter HI unity, we may approximate this ellipse by using radii a = .257 x HI, and b = .043 x HI.

If we call the diameter or major axis of the ellipse FG unity, we may approximate the ellipse by making a = .21 x FG, and b = .771 x FG.

For large drawings or very accurate work, we may approximate the ellipse closer by drawing ordinates spaced so as to give nine or eleven spaces and setting off the scale distances above and below the major axis, as found by multiplying the appropriate constant from the table below by the diameter HI or major axis FG, as required.



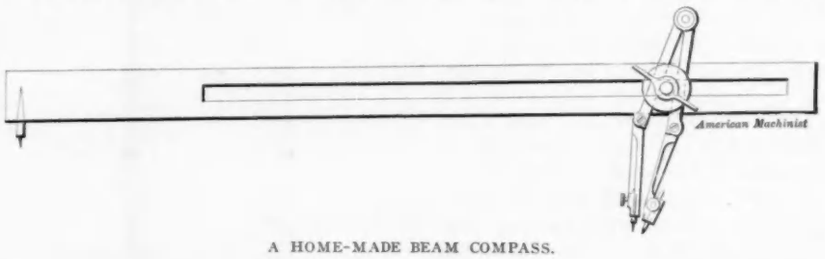


AN ISOMETRIC CHART.

A Makeshift Beam Compass.

Editor American Machinist:

Beam compasses are articles not frequently used by draftsmen, but they are wanted very much once in a while. I have originated a pair which have been for a long while a source of happiness to me. If similar compasses should make others happy the trouble of description will be more than repaid. In all respects except



A HOME-MADE BEAM COMPASS.

beauty they surpass the costly articles furnished by the dealers. A long stick, slotted for nearly its whole length, a needle point pushed into one end, and a bolt and winged nut to hold the ordinary compass in position are the component parts, all as shown in the sketch. In this particular case the needle point was taken from stock, the bolt and winged nut were secured by dissecting a double-headed Tee square, and the stick had once held a window in place. Half an hour's work with a jackknife did the rest. C. B. PERLEY.

Union Iron Works, San Francisco.

Lucian Sharpe.

We have previously published a brief anouncement of the death of Lucian Sharpe, of Providence, R. I., which took place October 17 at sea, while he was on his way home from Europe, whither he had gone chiefly on account of his health.

Though only a portion of Mr. Sharpe's life was spent in doing mechanical work, he began his life's work as a machinist and the manufacture of machinery was his business throughout all his subsequent career.

Mr. Sharpe was born in Providence March 29, 1830, and lived there all his life, except for a small portion of his childhood. His father was noted for certain qualities, which the son inherited, and which have been of great value in building up the world-famed establishment of which he was the head. These qualities were unusual physical vigor and strength, promptness and fidelity to obligations, industry and integrity, a fondness for reading and a retentive memory. Added to these were commercial talents and administrative ability of a high order.

His taste for mechanics led him, on graduating from high school, to become an apprentice with J. R. Brown, who had a small shop in Providence where he did particularly fine work—built tower clocks, made and repaired watches, clocks, surveying and mathematical instruments, etc. At this time Mr. Sharpe studied the French language, in order that he might read the best works on watch making, and his familiarity with that language was afterwards of much use to him in building up the foreign business enjoyed by his company.

Two years after the completion of Mr. Sharpe's five-year term of apprenticeship, a partnership was formed between the two men, Mr. Brown recognizing the ability of young Sharpe and offering him at a nominal figure a half interest in the business. The new firm was known as J. R. Brown & Sharpe, and occupied a floor space 60 x 30 feet, employing only a few workmen. In the work of building up from this small beginning Mr. Sharpe's position was chiefly commercial, and probably very many never suspected that he had had any mechanical experience. The fact is, however, that what he learned of mechanics in his earlier days never forsook him. He had read all the available literature of the time bearing upon his occupation, and remembered what he had read; often in after years referring his associates to certain books perused by him in his youth, which books contained descriptions of mechanical movements and devices thought to be new, but really old, and distinctly remembered by him.

In 1858 the firm became the manufacturers of the Wilcox & Gibbs sewing machine, and still retain that contract. It was this perhaps more than any other circumstance that led them into tool building. Tools and special machinery found useful in manufacturing sewing machines were first built by them for their own use and then for others. Mr. Sharpe was associated first with Mr. Brown, and later with Mr. Darling, both of whom were very fine mechanics and interested far more in the mechanical than in the commercial side of the business. This was given in Mr. Sharpe's charge, and he followed and supported their plans with untiring interest and ability. He was fully appreciative of the value of good work, and preferred that the work turned out of the establishment should stand higher than any other. His taste in machinery matters was discriminating and unfailingly good. He knew, when he looked at a machine, whether it were well or illy designed, and no work could be too well done to suit him so long as reasonable limitations and considerations of common sense were kept in view. Whenever for any reason the desired standard could not be maintained he preferred not to do the work.

One of Mr. Sharpe's strongest points, perhaps, was his faculty of putting responsibility squarely upon the shoulders of those holding the higher positions in the works, and then letting them very much alone, so far as dictation or interference was concerned. He held them responsible for results only, and left to those in whom he had confidence the free choice of means by which that success was to be attained.

LUCIAN SHARPE.

Personally, Mr. Sharpe was rather reserved and quiet in manner. He was simple, straightforward and direct. There was absolutely no affectation about him, and his manner and bearing toward the humblest apprentice or laborer were characterized by the same courtesy as would be shown to any others.

While he was exacting—held his employees up to a high standard—he was no less so with himself. He worked steadily and earnestly, and appreciated similar work by others.

Although quiet, he was a pleasant com-

panion socially, and the frequent visits he formerly paid to this office were always welcome and inspiring. He seemed to take a special interest in this journal from its inception, apparently because he believed in its educational work. It was this interest in educational work that led him to establish and maintain an excellent technical and general library, free to all employees.

The shops of his company are generally considered the best constructed and equipped shops to be found in the country, and they are so because he believed the best arrangements to be the most economical in the end, and that comfortable conditions are due employees as men, to say nothing of the fact that such conditions conduce to better and more efficient work.

Although interested to some extent in other affairs, Mr. Sharpe's business was mainly as a machine tool manufacturer, and as such his fame and name will live. As has been said of him: "His entire life was spent in the verification of Lord Chesterfield's maxim: 'Whatever is worth doing at all is worth doing well.'"

Mr. Sharpe leaves two sons, Lucian and Henry D. Both have been through a course of practical instruction in the shops, and since their father's failure in health, some time ago, have conducted the business. It is believed that they will prove fully competent for the work left for them.

Though Mr. Sharpe's own name does not appear as the inventor of important improvements, though he himself did no important mechanical or engineering work, he made it possible for others and encouraged them to do their best, and, what is equally important, had the commercial genius to find a market for their products. It would be extremely difficult to name a man who has done more for the advance of the art of manufacturing and for machine tool construction in America.

Bids for New Cruisers.

Congress, by the last naval appropriation bill, authorized the construction of six sheathed and coppered cruisers of 3,200 tons displacement, thus being a little larger than the "Raleigh" and "Cincinnati" class, the displacement of the last-named vessels being about 3,180 tons. The speed called for these new vessels is to be not less than 16½ knots, they are to have twin screws, and the limit of cost fixed by Congress is $1,141,800 each, and it is provided that not more than two of the vessels shall be built in one yard. The new ships will have a battery composed of ten 5-inch guns, eight six-pounders, two one-pounders and four machine guns. Bids for these vessels, which we here give, were opened at the Navy Department a few day sago.

Moran, Brother & Co., Seattle, Wash., one vessel on the department's plans, $1,122,000.

William R. Trigg & Co., Richmond, Va., one vessel, department's plans, $1,027,000.

Same company, bidders' plans, one vessel for $1,044 000, speed guaranteed 18 knots; two vessels, same type, for $937,000 each.

Same company, bidders' plans, one vessel for $1,073,000; same type, two vessels for $1,027,000 each.

Same company, bidders' plans, guaranteed speed of nineteen knots, one vessel for $1,079 000. Two vessels, same type, for $1,039,000.

Fall River Engine Company, Braintree, Mass., one vessel on the department's plans modified, $1,065,000. Two vessels, same type, $1,020,000.

Same company, bidder's plans, speed of 18 knots and bunker capacity 866 tons; one vessel for $1 065,000. Two vessels of the same type, $1,020,000 each.

Same company, bidder's plans, displacement, 3,200 tons; speed, 18½ knots; one vessel for $1,100,000. Two vessels, same type, each $1,060,800.

Burlee Dry Dock Company, of Port Richmond, Staten Island, N. Y., for department's plans, one vessel for $1,105,000.

Neafie & Levy Ship and Engine Building Company, of Philadelphia, department's plans, one vessel for $1,050,000; two of the same type for $1,030,000 each.

Townsend & Downey, of New York, one vessel, builders' plans, $1,059 000; two for $1,055,000 each.

Same bidders, department's plans, one vessel, $954,500; two vessels, same type, $950,000 each.

Columbian Iron Works, of Baltimore, one vessel on department's plans, $1,116,000.

Union Iron Works, of San Francisco, one vessel on the department's plans, $1,041,000.

Bath Iron Works, Bath, Me., one vessel on department's plans, $1,041,650.

Lewis Nixon, Elizabethport, N. J., one vessel, department's plans, $1,039,966.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Rawhide, fibre and hard rubber gears. The Arthur Co. (See page 8.)

Construction and repair of Commutators, 50c. L. C. Sharp, Omaha, Neb.

Light and fine mach'y to order, models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

Wanted—New or second-hand universal grinding machine. Timken Carriage Co., St. Louis, Mo.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

For Sale—Two geared Ferracute presses. 62 in. between uprights; little used, and in good condition. Address W. H. Mullins, Salem, Ohio.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. by G. W. Dixon, Spring Lake, Mich.

For Sale—Porter lathe, 14 in. swing, 8 ft. bed; also portable forge, anvil, emery grinder, and press drill for hand or power. Eclipse Mfg. Co., Gloversville, N. Y.

Engineers and firemen, send 2 cents for 24-page pamphlet containing list of questions asked by Examining Board of Engineers. Geo. A.Zeller,bookseller,St.Louis,Mo. Mention A. M.

A mechanical engineer of broad experience in the manufacture of all grades of machinery, desires to invest some capital and secure a position; can furnish first-class references. Address "Imperial," AMERICAN MACHINIST.

For Sale—One 20 horse-power horizontal tubular boiler, with pumps, inspirator, heaters, etc., and one Armington & Simms 50 horse-power engine; all in first-class condition. Inquire Box 407, AMER. MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Purchasing agent will change position. Address Box 402, AMERICAN MACHINIST.

Mechanical draftsman; first-class designer; mill work preferred. Box 406, AM. MACH.

Traveling (machinery) salesman; first class. Address Box 401, AMER. MACHINIST.

Advertising manager; thorough in machine tools. Address Box 403, AMER. MACHINIST.

Mechanical draftsman wants situation; has had 8 years' drawing-room experience. Box 405, AMERICAN MACHINIST.

Experienced foreman, building 14 to 36-inch engine lathes, open for engagement; best of reference. Box 394, AMERICAN MACHINIST.

Party with machine shop and drafting room, general supervision of details and management of labor, desires a situation. Box 1429, Boston, Mass.

Wanted—Situation, by superintendent who wishes to change; position in factory employing from 300 to 500 men. Address Box 395, AMERICAN MACHINIST.

Wanted—Position as foreman machinist; 12 years' experience on engines, compressors and general machine shop work. Box 399, AMERICAN MACHINIST.

A toolmaker who has had experience in designing special tools, jigs and on experimental work, wants similar position. Box 404, AMERICAN MACHINIST.

Draftsman and designer of Corliss engines, air compressors, automatic machinery, etc., desires change; competent to take charge. Box 381, AMERICAN MACHINIST.

Situation wanted by a first-class mechanical draftsman and designer; 14 years' experience in Corliss valve engines and air compressors. Address Box 397, AMERICAN MACHINIST.

A mechanical engineer of broad experience in the manufacture of all grades of machinery, desires to invest some capital and secure a position; can furnish first-class references. Address "Imperial," AMERICAN MACHINIST.

Superintendent, at present in charge of a large machine shop, will be open for engagement December 1. Parties requiring the services of an up-to-date man in this line will not regret addressing Box 396, AMER. MACH.

Superintendent or master mechanic, by mechanical engineer; 20 years' experience shop management; practical cost cutter; thorough organizer; hustler; up to date; wide experience; highest commendations; would invest in business if satisfactory. Address Box 400, AMERICAN MACHINIST.

An efficient mechanic with broad experience in manufacturing, building machinery, designing and making tools for manufacturing duplicate work commercially and up to date, will be open December 1 for position as foreman or superintendent; good systematizer and manager; A1 references. Box 398, AM. MACH.

Help Wanted.

Wanted, at Once—Three capable men for general machine work. Greenwood Bros. & Co., So. Gardner, Mass.

Wanted—Detail draftsman and experimental hands on shoe machinery. McKay Metallic Fast. Assn., Winchester, Mass.

Wanted—Experienced structural draftsman and architect for mill buildings. Address Engineering Co., Box 2, Cleveland, O.

Wanted—A draftsman; one who has had experience on electric or hand traveling cranes. Box 388, AMERICAN MACHINIST.

Wanted—First-class diemaker, familiar with sheet-metal work. Address Grand Rapids Hardware Company, Grand Rapids, Mich.

Wanted—Experienced sealer and adjuster weighing scales; state positions held and wages. Address "Scale," AMER. MACHINIST.

Wanted—Foreman for machine shop. Apply by letter only, stating qualifications and experience, Hilles & Jones Co., Wilmington, Delaware.

Wanted—Five first-class machinists, familiar with high-grade machine tool manufacturing; give age and experience. Landis Tool Co., Waynesboro, Pa.

Wanted—Draftsman, thoroughly experienced in duplex pump work, by concern located in Ohio; state age and experience. Box 393, AMERICAN MACHINIST.

Wanted—Foundry foreman; chief work light and heavy power transmission; foundry equipped with air hoists and molding machines. Box 389, AMERICAN MACHINIST.

Wanted—A first-class machinist; a young man who can work on tool work and other work if necessary; give age and experience. Address Box 408, AMERICAN MACHINIST.

Wanted—Foreman for machine shop employing 40 men, in New York city. Address, giving experience, reference, age and salary expected, Box 409, AMERICAN MACHINIST.

Wanted—Experienced mechanical draftsman on electric generators and other electrical apparatus. Address, with full particulars, Stanley Electric Mfg. Co., Pittsfield, Mass.

Wanted—Machinists, floor and lathe hands; must be strictly first-class men, sober and reliable; permanent position to good men. Address Robinson Machine Company, Monongahela, Pa.

Machinists wanted; a number of first-class men on high-speed marine engine work. Apply Gas Engine & Power Co. and Charles L. Seabury & Co., Consolidated, Morris Heights, New York City.

Wanted—First-class operator for Gisholt lathe; one who has had experience in making and designing tools preferred; state fully experience, age and wages expected. Address Box 391, AMERICAN MACHINIST.

Machinists wanted; a few good lathe, planer and milling-machine hands, for steady work; location a short distance from New York. Write, stating ability and where previously worked, to Box 368, AMER. MACH.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite applications from draftsman, pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Superintendent for large cycle works in England; must be a thorough mechanician and possess thorough knowledge of systematic cycle manufacturing and the handling of men; reply with full information as to former engagements and give references. Churchill, Leonard st., Finsbury, London.

Wanted—Three good planer hands who can plane lathe and planer beds, etc.; also four good fitters on machine tools and two good draftsmen on machine tools; also lathe, planer and vise hands. Address Box 387, AMERICAN MACHINIST, and state wages wanted and experience.

Wanted—A first-class and experienced engineer with energy and push, to take charge of drafting room of engineering firm, constructing machinery and steel structures; state age, experience and reference; permanent position; salary in proportion to ability. Address Engineering Co., Box 2, Cleveland, O.

Wanted—An assistant superintendent for machine shop and foundry manufacturing engines and work of like nature; must be a good draftsman and practical machinist; in answering, state age and experience, giving reference and salary expected; location is in Middle Atlantic States. Address Box 392, AMERICAN MACHINIST.

Wanted—A young man with good education, as general foreman or assistant superintendent of a shop manufacturing high-grade machine tools; factory new and strictly up to date; only A1 men with experience in manufacturing machine tools and thoroughly familiar with modern machine-shop practice, need apply; must also know how to handle men to best advantage; a splendid opportunity for the right man; state age, experience (fully) and salary expected. Address Box 390, AMERICAN MACHINIST.

MACHINISTS WANTED.

15 Active, Capable Machinists

Wanted at once on high-grade work.

American Turret Lathe Co.,
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MY SHOP is fitted with modern tools and I employ modern methods only in my work. I want to build Special Tools and Special Machines for people who want such things right. Write me at
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CROSS OIL FILTERS
in use. Better let us send you one on 30 days' trial.
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Of all descriptions.
Get Our Prices.

FINEST QUALITY OF REAMERS.
Patent Spiral Flutes, "LIGHTNING and GREEN RIVER" SCREW PLATES, Taps, Dies, etc.

SEND FOR CATALOG.

WILEY & RUSSELL MFG. COMPANY, GREENFIELD, MASS., U. S. A.
Agents in London: SELIG, SONNENTHAL & CO., 8g Queen Victoria Street.

An English School of Instruction in the Use of Automatic Tools.

The "Yorkshire Post" announces that during the coming winter, at the Northampton Institute, Clerkenwell, classes are to be opened for training mechanical engineers in the construction and use of automatic tools for making interchangeable parts. It says, in addition to the announcement:

"The matter is one of much importance to many branches of trade. The watch industry has almost been driven out of the country by the introduction of cheap American and Swiss machine-made watches, which are cheap mainly because the 'parts' are turned out wholesale by machinery. Another form of American competition closely allied with that just mentioned is the manufacture of machine tools. English engineering shops are full of them, and English manufacturers in some cases admit their superiority to home-made goods. Against both forms of competition the instruction to be given in the Northampton Institute will be aimed. A beginning is to be made with the watch trade. There will be two courses of lessons, one for day students willing to give practically the whole of their time, and the other for apprentices able to attend only on two afternoons a week. From the syllabus it is clear that the experiment is to be thoroughly tried. We have pleasure in directing attention to it, because it strikes out a new line of technical education which in several industries is worth imitating."

Personal.

M. C. Krarup will shortly sever his connection with the "Motor Age" and the Cycle Age Publishing Company, of Chicago. Mr. Krarup has for some time been editor of the above named journal.

Mr. Robert Sulzer, of Winterthur, Switzerland, is over here, and expects to take a position in some American engine building shop. He is a mechanical engineer and a younger brother of Carl Sulzer, of the famous engineering firm.

Obituary.

George Andrew, of the firm of Phalen & Andrew, proprietors of the New York Iron Works, Bethune street, New York, died October 31, sixty-three years old. Mr. Andrew was born in Scotland, and came to this country in 1854. He worked first as a boilermaker in the shop of which he became a proprietor, he as foreman of the boiler shop and Mr. Phalen foreman of the machine shop, assuming the business after the death of the original members of the firm of Cobanks & Theall.

Inquiry for Machinery.

(112) Machinery used in the forging and cutting of files and rasps.

November 13 has been set aside as New York day at the National Export Exposition, and the Merchants' Association of New York is arranging for a special trip of New York merchants. H. D. Lockwood, New York Life Building, has charge of the matter.

Manufacturers.

Ahrens & Ott Manufacturing Company, Louisville, Ky., will erect a three-story brick factory and warehouse.

G. C. Dougherty, 726 South Fifteenth street, Philadelphia, Pa., intends erecting an addition to his plant at that address. It will be three stories and basement.

Charles F. Felin will build a three-story mill at the northeast corner of Thirteenth and Pike streets, Philadelphia, Pa., the dimensions of which will be 83 by 40 feet.

The business heretofore conducted by Ott. Mergenthaler & Co., Baltimore, Md., will be continued on the same lines, and with same personnel, by the Ott. Mergenthaler Company, recently incorporated.

J. F. Buchanan & Co., of Philadelphia, Pa., have been awarded a contract for an electric lighting plant to be erected at Perkasie, Bucks County, Pa., for that borough. It will cost $11,500 and will include a power-house, with necessary power equipment.

The announcement has been made that there is to be a combination of the large sheet brass and copper concerns about Waterbury, Conn. The combination will include the works of Wallace & Son, Ansonia, recently bought by the Coe Brass Company, of Torrington; the Waterbury Brass Company, of Waterbury; the Ansonia Brass & Copper Company, of Ansonia, and the works of the Coe Brass Company, at Torrington.

New Catalogs.

R. M. Clough, Tolland, Conn., has sent us copy of catalog and price list of gear and milling cutters, reamers, gages and other small tools, also a pamphlet describing a vertical milling machine having a slotting attachment.

Theo. Alteneder & Sons, Philadelphia, send us a copy of the eighteenth edition of their catalog and price list illustrating and describing a full line of drawing instruments. The various points of the instruments are described in careful detail. The catalog is 5x7½ inches.

Buffalo Forge Company, Buffalo, N. Y., sends us copy of folder in which are illustrated and described recent designs of their engines. The various features of these engines are enumerated. The engines shown are of horizontal and vertical construction. The folder is 3½x6½ inches.

Kingsford Foundry & Machine Works, Oswego, N. Y., sends us catalog describing centrifugal pumping machinery. These pumps are made to be operated by belt or direct by engine, and are provided with self-oiling bearings, solid scrolls and other novel features. The catalog is 3½x6½ inches.

We have received catalog of the "Caldwell" water tube safety boiler made by the Caldwell Water Tube Boiler Company, Erie, Pa. Internal views of this boiler, showing arrangement of tubes and other parts are given, together with illustrations of various installations. The catalog is standard size, 6x9 inches.

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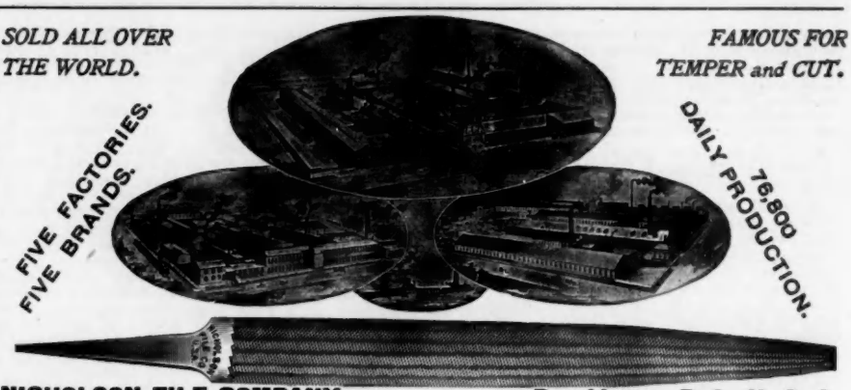

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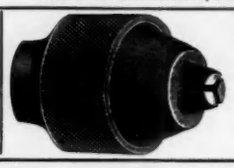

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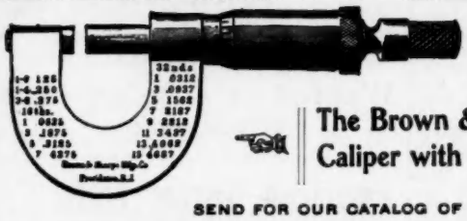

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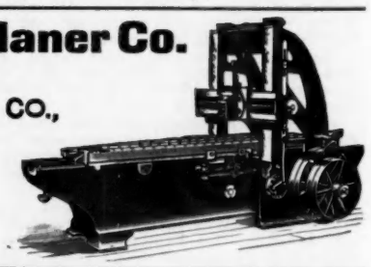

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or Carbide of Silicon in the place of ferro-silicon. They found that Carbide of Silicon was very high in Silicon—about 62 per cent. They found that it was easier to use because each package is marked with its exact proportion of silicon. They found it absolutely pure. You will find it so. We'll send you enough to make a test, free of charge. As an abrasive, Carborundum is the best substance known.

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